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Competition on Reclaiming Scrap Material

You will still have a few days on receipt of this number to finish and send in your contribution to the competition on Reclaiming Scrap Material, which closes February 15, 1912, a prize of $35 will be given for the best paper on the subject and one of $20 for the second best. Articles not awarded prizes, but accepted for publication will be paid for at our regular space rates. We want to bring out all the practical information possible on the reclaiming of scrap and as to how far this work can be carried with good results. Full announcements of the competition were made in the January issue.

Give Your Equipment a Fair Show

On a locomotive equipped with a high degree superheater, a visitor was recently astonished to observe that the inside and part of the lower face of the cylinders were not lagged in any manner. This is an illustration of the reason why a device in actual practical service often does not show the economy which it did in experimental service; while the superheater appears to be able to hold up its end under the most severe handicaps, it is not improbable that carelessness of this kind might be responsible for the discarding of a device which under reasonably fair conditions would prove successful.

Railway Shop Improvements During 1911

The first prize of $35 in the competition on Shop Improvements during 1911 has been awarded to William G. Reyer, general foreman of the Nashville, Chattanooga & St. Louis shops at Nashville, Tenn. The second prize of $20 goes to C. C. Leech, who until recently was foreman in charge of the Buffalo shops of the Pennsylvania. Both of these men considered the subject from entirely different view points. Mr. Reyer briefly covered the general improvements which had been made and then considered a number of important time and labor saving kinks which had been introduced at Nashville during the year. Mr. Leech, on the other hand, described the changes which had been made in the arrangement of the buildings and equipment at Buffalo during the year.

Drop Testing Machine

The drop test forms a part of the specifications of a number of the more important pieces of railway equipment and in the larger railway testing departments the drop testing machines come into very frequent use. The Baltimore & Ohio, in replacing an old machine, has installed an electrically operated apparatus which gives a maximum drop of 60 ft. It is, in many respects, a very decided improvement over the customary arrangement. A magnet is used for hoisting the tups and the height of the drop may be accurately determined and quickly altered without the necessity of climbing up the column and adjusting trips. Furthermore safety devices have been most carefully provided which seem to make it practically impossible for an accident to occur which might result in the injury of the operators or in spoiling a test. This machine is fully illustrated and described in another part of this issue.

Engineer's Wind Shield

In zero weather, especially in cases of snow and sleet and on rapidly moving trains, it is necessary for an engineer to close the cab window and to operate his train with practically no view ahead except a quick survey of the signals, the exact location of which he knows. If the cabs are provided with a narrow hinged window that may be swung out and fastened and act as a wind shield and can also be quickly and easily wiped clean, the necessity and desire of closing the side window even in very cold weather is practically eliminated. These shields not only permit a clear view ahead without being blinded by snow or rain but also largely keep the cold wind out

of the cab and from the engineer's projecting arm and shoulder. They are simple, cheap and easily applied and no locomotive operating in passenger service should be without them, especially during winter weather.

Low Water Alarm for Locomotives

When a locomotive boiler explodes, the evidence in a great majority of cases indicates that the cause is low water. While no engine crew would intentionally permit the water level to reach a danger point, the fact that it does do so, in some cases without any fault or inattention on the part of the crew, indicates the value of greater safeguards in this direction. On some divisions of the Southern Pacific, the locomotives are now being equipped with an apparatus which automatically blows a whistle and dampens the fire whenever the water level reaches the danger point. The passages to this apparatus are made sufficiently large, so that the possibility of their becoming clogged is very small, and even though the water glass or gage cocks may be out of commission, the alarm will probably do its duty. The apparatus, as may be seen in the description on another page, is not expensive and requires very little maintenance. The expense of a single dropped crown sheet would be sufficient to equip a whole division with an alarm of this type.

The Next Shop Kink Competition

Don't forget the shop kink competition which was announced last month to close March 15, 1912. Any labor or time-saving kinks or devices which are used in the locomotive or car departments will be eligible. A prize of $50 will be awarded to the contributor with the best collection of three kinks, and a second prize of $25 will be given for the next best collection. More than three kinks may be submitted, allowing the judges to base their decision on what they consider to be the best three in the collection. Kinks not awarded a prize, but accepted for publication, will be paid for at our regular space rates. The devices should be clearly and fully described. Too many of our contributors err on the wrong side, making their explanations incomplete and entirely too brief. A prize winning kink may be so poorly described that its advantages will not be at all apparent. The illustrations may consist of sketches, drawings, blue prints, or photographs. While it is not necessary that the contributor should have designed the kinks it is always advisable, wherever possible, to give credit to the man or men who did design them.

Good Ideas Are Worth Money

Men of all grades on a railway are in position to suggest improvements in both methods and appliances for the work with which they are most closely associated, and in many cases will go to great personal inconvenience to have an improvement installed which often results in decided economy for the company. Unfortunately, in some cases it is with so great difficulty that things of this kind can be done that the initiative of the men is completely destroyed and they not only make no suggestions, but to some extent lose their loyalty to the company. A few railway companies are recognizing the importance of stimulating the activity of their employees in this direction, and are even going to the extent of offering to pay a man for all ideas which prove practicable. The results are remarkable. Even under ordinary conditions suggestions are numerous, but when a reward is offered, the possibilities of resulting economies are surprisingly great. On the Buffalo & Allegheny division of the Pennsylvania Railroad, where prizes are given for such suggestions, it has been found that practically all classes of employees respond; while many of the suggestions are worthless, there are so many that are valuable that it pays well to carefully investigate the possibilities of each one.

Coal for Locomotive Stokers

Automatic stokers for stationary boilers almost without exception, require prepared coal, but designers of stokers for locomotives have from the beginning attempted to use the regular run of mine coal; it is quite possible that this effort is largely responsible for the failure of some of the designs. Those that have proved successful, however, have by different means crushed the coal before it was actually put into the firebox and in this way have overcome the apparently serious handicap of using the unprepared run of mine coal. In the Street stoker an entirely separate apparatus has been used for this purpose, while in the Hanna and Crawford designs what is in effect a crusher forms part of the apparatus. If prepared fuel were furnished stoker locomotives, not only would their operation be more reliable and efficient, but particularly in the case of the Street stoker there would be a decided reduction in the weight and in the amount of machinery required. As is shown elsewhere in this issue, where suitable fuel can be obtained, Mr. Street is now equipping locomotives with the screw conveyor, and entirely doing away with the crusher and its engine on the tender. Coal suitable for stoker use, i. e., everything that will pass through a 2-in. screen, can be purchased at the mine at the present time at a considerable reduction over what run of mine costs. When it is considered that on a division having 100 locomotives equipped with stokers there will be 100 small crushers operating uneconomically and using power that is needed to pull trains, when a few crushers at the coaling stations would do the work better, the unsoundness of the practice is evident. It would be as sensible to have small dryers on each locomotive for preparing the sand. Some few roads are recognizing this fact and are furnishing stoker locomotives with suitably prepared fuel to the great advantage not only of the firemen, but of the fuel consumption, and the reliability of the stoker operation. Other companies considering the application of stokers should arrange to do likewise.

Volume of Locomotive Fireboxes

How many cubic feet of firebox volume should be allowed for each square foot of grate area in order to get the most complete combustion? It probably varies directly as the amount of volatile matter in the fuel, but there seems to be little definite information on the subject with any grade of fuel. The government is carrying on tests on this subject which seem to indicate that the larger the volume the more efficient the combustion, but the proper limit or most efficient point has not yet been determined. Practical experience in locomotive fireboxes indicates much the same thing and tests made by blocking off a fair proportion of the grate show a decided increase in the efficiency of the boiler, in some cases, even with no decrease in capacity. Boilers with large combustion chambers give as great or greater evaporation than those having the similar space filled with tubes, and in fact with soft coal everything seems to indicate that an increase in the relative volume of locomotive fireboxes over the customary size would give an improvement, but there seems to be little information as to the rate of improvement or what the limit should be in this direction. The old narrow firebox was notoriously a better steamer for its size than the present wide type as generally constructed and it, of course, had a decidedly larger ratio of firebox volume to grate area than the present design; this fact may be responsible for some of the results.

As is recorded on another page, Mr. Gaines, of the Central of Georgia, has been most successful in some experiments in this direction. He erected a hollow brick wall across the forward end of the grates, making the firebox of sufficient length to give the required grate area back of the brick wall and thus form a combustion chamber within the firebox itself, giving an increase in relative volume of about 25 per cent. Owing to the fact that he admits air through the hollow wall, which is discharged backward at about the center of the firebox, it is difficult to determine

from the figures available how much of the increased evaporation obtained is due to the increased volume and how much to the admission of air at a high temperature at the point where it will do the most good. Some work in this direction has been done in the locomotive testing plant at Altoona and it is to be hoped that the results may later be made generally available. It will be noticed in connection with Mr. Gaines' design that the increased volume is obtained by increased length, offering an opportunity for a considerable decrease in the height of the box even to the point of the entire elimination of the front water leg permitting the installation of large wheels under the firebox in practically the same manner that is possible with the Wootten type boiler.

Steel Passenger Cars In Wrecks

Steel passenger and sleeping cars are now in sufficiently general use to give an opportunity of determining with some degree of accuracy their actions when in wrecks. On the whole there is no doubt but what they are a wonderful success in this particular, and have already resulted in a saving of many lives. In cases where they have been thrown from the track, rolled down the embankment and otherwise misused, which would have resulted in many fatalities with the ordinary wooden car, the passengers have usually all escaped with but minor injuries and no fire has been present to destroy those who were trapped in the wreck. In fact in the one feature of the absence of fire in bad wrecks, the steel car is worth all it costs.

In the case of actual collisions, however, especially those where the rear end of a train is struck by a rapidly moving locomotive and train, there have been a number of fatalities in steel cars. Possibly the most disastrous of these was in the wreck on the Chicago, Milwaukee & St. Paul at Odessa, Minn., on December 12, where 10 persons in the steel sleeping car were killed and 11 injured. In this case the steel sleeping car was the last car on the train, and just ahead of it was a heavy steel diner, and ahead of this were 5 cars and a large Pacific type locomotive. This train was barely moving after a stop when a Pacific type locomotive of the same class as the one on the passenger train, drawing 6 loaded, 30-ton, refrigerator cars and operating at very high speed, ran into it. The locomotive plunged into the rear end of the sleeper, which was the smoking compartment and, destroying the combination end sill, entered the car as far as the rear end of its cylinders. This action apparently tended to lift this end of the sleeper and to depress the forward end so that it passed under the underframe of the dining car, which then telescoped into the sleeping car for a distance of one-third of its length, demolishing the vestibule and end framing, spreading out the sides and crumpling up the roof. The underframe of the dining car, which was of the standard Pullman construction, was little damaged, and the same holds true of the forward part of the sleeping car underframe. There was practically no damage ahead of the dining car, in fact the forward vestibule of the diner itself was practically uninjured.

One of three things with this class of equipment should be provided. Either the upper plate and end construction of the vestibule should be made equal in strength with that of the underframe, so that there will be sufficient resistance to prevent telescoping even when one underframe rises above the other; or the vestibule including the underframe should be made of lighter construction as far back as the body end sill so that they will crush and absorb the shock without injury to the car body; or some method should be designed that will positively prevent one underframe from rising above the other under any circumstances. It is also possible that the body of the car could be constructed to become so distorted, in case of a collision of this type, that it would absorb the blow without being crushed. While collisions of this particular character seem to be the only vulnerable point of the steel car, and they happily, are comparatively infrequent, nevertheless the cars to be a complete success, must be prepared to withstand even this test.

Reclaiming Scrap Material

In the effort to increase the efficiency of the mechanical department several roads have been giving close attention to the question of reclaiming scrap material. On the Chicago & North Western the superintendent of motive power and machinery, Robert Quayle, the superintendent of the car department, C. A. Schroyer, and the general storekeeper, W. M. Carroll, recently made a trip of three weeks, visiting every important division and repair point on the road, and carefully examining the condition of the shops, store houses and scrap bins and their surroundings to see that usable material was not scrapped or wasted, or was not kept in excessive quantities, or in such a way that it could deteriorate. In looking over the plants, memoranda were made of things which were not as they should be, and a usable bolt or some similar part, which had found its way into the scrap pile, was picked up and used as an illustration in a little conference with the local officers which was held after the inspection was completed.

The conference was held in a business car, if there were only a few men to be present, or in a large office or hall if the car was not large enough to accommodate all those whom it was desired to have present. These gatherings were usually made up of the general superintendent, if he happened to be located at that particular division point, the division superintendent, trainmaster, bridge department foreman, traveling engineers, master mechanic, general foreman, engine house foreman and the foremen of the various departments in the shop.

Attention was directed to the fact that it is quite often necessary to reduce the expenses of the mechanical department for a period of greater or less length, and that in such cases the ordinary practice is to cut down the pay roll. Usually the first men to be laid off are the laborers employed about the shop who can be spared much more easily than the more skilled workmen, but who at the best receive a small wage and can ill afford to remain out of work for any length of time. The suggestion was then made that the same saving or economy could be brought about without the laying off of these men if all of the employees would co-operate in an effort to reduce the loss or waste of material to a minimum. On a large road the cost of material used in the mechanical department is as great or greater than the cost of labor, and the indications are that by co-operation, a sufficient saving could be made to prevent a large part of the fluctuations in the working time of the force. For instance, all the scrap is supposed to be carefully sorted out at each point and only that forwarded to the main shops which cannot be used and must be sold. In spite of this the scrap which was shipped to the main shop last year contained $275,000 worth of usable material. It is true that this material was finally saved, but the cost of handling it and shipping it to headquarters and reshipping it to outside points for use would have gone a long way toward producing the economies which are so much needed.

The speaker would then show a bolt which was in good condition but had found its way to the scrap pile. Such a bolt might cost 6 cents. The annual report last year showed that it cost .89 cents to haul a ton of freight one mile. It would therefore be necessary to haul a ton of freight eight miles to secure enough revenue to pay for a new bolt. One man at $1.50 per day can pick up $12 worth of usable material. Would it not be a paying proposition to have such a man and provide him with a small amount of equipment for straightening and reclaiming damaged material?

The way in which a railway must practice economy may be illustrated by the way in which the children in a large family are clothed. The oldest boy's clothes are made over for the next boy, and so on down the line until they have been completely worn out. The cost of transportation is fixed by law, and since it is impossible to secure the necessary revenue by increasing the freight rates, ways must be devised of cutting

down the expenses in order that the property will not depreciate.

A new era has been reached in the history of railways. With government regulation as to the safety appliances for rolling stock, the care of boilers and the making of rates it is not altogether improbable that sooner or later the government will want to look into the problem of efficiency to see if the roads are properly directed. When such a time comes, in order to protect the roads from government ownership and its evils, it will be necessary for those in charge to show, like the man with ten talents, that they have handled the property wisely and have not neglected it, as did the man with one talent.

Undoubtedly those who read this will suggest that railway affairs or reforms travel in cycles, and that although great improvement may temporarily follow the inspection by this efficiency committee, as it might be called, still it will be only temporary, and in another 6 months or more the men will have forgotten all about it and the lessons which were so forcibly taught them. The men in charge of the movement, however, are big enough to prevent this, and undoubtedly for the next year they will arrange to follow the matter up at least once every 3 months to see that the movement is started right and that the men get into the habit of using material properly.

Electric Shop Kinks

The transmission of power for small portable tools, hoists, presses, etc., in railway shops is almost entirely by compressed air; the practice has grown to such an extent that the space in the power house occupied by the air compressors required for these numerous small operations is nearly as large as that for the steam engines and electric generators which supply power to the large machine tools. In some shops the pneumatic motors, hoists and other tools require a compressor capacity of 10,000 cu. ft. per minute, representing 1,500 boiler horse power, which is nearly equal to the power required to operate all the shop equipment driven by other methods. At the passenger power house of the Pullman Company there are three air compressors with a total capacity of 12,000 cu. ft. of free air per minute, and at the new freight power house of the same company there are two air compressors each of 4,000 cu. ft. capacity, or a total of 8,000 cu. ft.; a total for the two plants of 20,000 cu. ft. of air, which, compressed to 100 lbs., represents about 3,000 h. p.

The actual useful work performed by the various pneumatic tools and motors in any shop is but a small proportion of that available in the steam used by the air compressor; in other words, the efficiency of pneumatic motors is low and there is a large loss by leakage and by friction in the transmission of compressed air at 100 lbs. pressure through pipes distributed over the large area of a railway repair shop. These are the reasons why with the increasing use of pneumatic motors and shop kinks operated by compressed air, very large and expensive air compressors are required.

It is doubtful if this low efficiency of air motors and the loss in the transmission by pipe friction and leakage has been fully appreciated by motive power officers and engineers concerned in shop and power house equipment, for it it was, the superior efficiency of electric motors and electric transmission would have been more largely availed of for the smaller motors and shop kinks of various kinds which require power or pressure. The small electric motor for drills, reamers, taps and other similar portable tools has already been substituted for the air motor, and in several instances it is manufactured by the same companies. The electric drive has also been developed for hoists, riveters, chipping hammers and most other portable tools which heretofore have been driven by compressed air.

For a new plant it is possible to eliminate the majority of air appliances, and a large capacity in air compressors need not be provided. In some railway repair shops the large air compressor has been eliminated from the power house equipment and a number of small compressors are distributed through the plant, one for each shop building where pneumatic tools are used. These compressors are electrically driven and arranged to automatically start and stop by pressure governors. Compressed air is seldom required in all departments day and night, and when the whole plant is supplied by one large compressor it must be operated at night under extremely uneconomical conditions to supply a few air tools in one shop. With the improvement of electrical appliances, covering a wider range and a greater variety of work, the size of the air compressors may be reduced and their installation confined to a few of the shop buildings, thus largely reducing the length of the main air pipe and preventing large losses by leakage.

Compressed air has its legitimate field and should not be entirely eliminated. The air hoists for lifts of three to five feet and pneumatic jacks and presses are convenient, economical and efficient appliances which have come into general use and should be retained. They have the merits of simplicity, low first cost and light repair charges, and are typical of the kind of appliances to which compressed air is best adapted. The flow of air is intermittent, its application fairly efficient and the volume of air required is comparatively small. Where a constant flow of air is required, as in rotary pneumatic motors for drilling holes, and for tapping and threading for staybolts, the volume of air is large and its application very inefficient. The same is true where an air jet is used in connection with oil furnaces, rivet forges and other places where a continuous flow through a small nozzle represents a large consumption of compressed air, compared with that required for pneumatic hoists.

We have headed this editorial Electric Shop Kinks, because most of the so-called shop kinks which require power have usually employed compressed air, and some reform in the future developments of these useful appliances is necessary in order to adapt them to the use of the electric transmission of power. The extensive application of compressed air is seen in the various devices illustrated in the book on Railway Shop Kinks, where it is almost universal, while there are only one or two examples where electric power is utilized. A conspicuous instance illustrates the limitation of air and the greater flexibility of electricity. A jib crane for a flange fire is fitted with the usual pneumatic hoist for short lifts, and on the same jib is an electric chain hoist which permits of the longer lift required for the large plates for locomotive fireboxes.

The almost universal use of compressed air for driving portable home-made shop tools and appliances is due to the fact that small pneumatic motors were easily made in the railway shops and pipes were laid for air transmission before electric motors were used for shop purposes. The ordinary machinist could readily understand the construction of the air motor, and he found numerous and ingenious methods for its application. It was easily adapted to portable tools, and this led to the extensive development of labor-saving devices where power was employed instead of hard work. Since the electric motor has been so generally introduced for driving machine tools and the shops are fully equipped for electric transmission, advantage has not been taken of its efficiency, and it has not been utilized for the smaller shop appliances requiring power, partly from habit and experience with the familiar air motors, and partly because electric devices are not so well understood by the average mechanic.

With the electric lighting of shops and passenger cars, and the general use of electric-driven machine tools, has come the "railway electrical engineer," and it should be a part of his duty to assist in the development of electric shop kinks for railway plants. At the November, 1911, meeting of the Association of Railway Electrical Engineers this responsibility was recognized in the report on shop practice, which called attention to the large increase in compressed air consumption in railway shops. In the next report the committee proposes to present definite figures

regarding the cost and efficiency of compressed air and its application to pneumatic tools and other fixtures. These will be compared with the efficiency of small electric motors and appliances which may be substituted for those driven by air. In this important investigation the railway shop superintendent and testing engineer should render all necessary assistance and cooperation, for it is one which will secure valuable data leading to a radical change in the application of power to portable tools, and resulting in important savings in the cost of shop labor. It should justify a larger substitution of electric motors for air motors, and the utilization of electric transmission in places where hand power is still employed.

The use of electrically driven small portable saws and emery wheels could be largely extended, especially in the construction and repairs of steel cars. These small grinders find a large field of application in the outside finish of steel passenger cars, and larger portable emery wheels can be used in grinding the bearing faces of locomotive frame pedestals and for sharpening milling cutters in place on the machines. The small electric motors can be used for driving fans and blowers, which may take the place of the wasteful air jet. There is also a large field for the utilization of the electric current in the magnet. Magnetic clutches are not yet fully developed, and there is wide opportunity for invention in numerous applications of this principle. There is nothing more convenient than a magnetic face plate on a lathe for turning piston packing rings, and magnetic clamps should be made so reliable that they would be utilized for holding small pieces on planers, shapers and drill presses. When the superior economy, flexibility and convenience of electrical devices for portable shop tools are better understood, there will be a development of electric shop kinks more numerous, more interesting, and more economical than that which has utilized compressed air for power transmission. We shall welcome descriptions of electric kinks.

NEW BOOKS

Elementary Applied Mechanics. By Arthur Morley, professor of mechanical engineering, and William Inchley, lecturer and demonstrator in engineering in the University College, Nottingham, England. 382 pages. 261 illustrations. 5 in. x 7½ in. Cloth bound. Published by Longmans, Green & Company, 91 Fifth avenue, New York. Price, $1.00.

This book deals with the subject of elementary applied mechanics in a very complete way, entering into all the different phases of the subject in a concise and simple manner. It is especially useful to the young man that does not have an opportunity of attending a technical school where the subject is taught, and is a first class text book for apprentices or students who are not taking up engineering along prescribed lines. It is divided into twenty-seven chapters, which deal with the subjects of force, work, friction, power, strength of materials, statics, motion, energy and hydraulics. The book is rather small to cover so wide a field, but the subjects are treated in such a way that most any student can more or less easily assimulate the elements of the subjects considered.

New York Air Brake System. A Detailed Description and Explanation of the Operation of the New York Air Brake. Compiled and edited by leading air brake experts. Illustrated by colored diagrams. Frederick J. Drake & Company, Chicago. Cloth, 5½ in. x 8 in., 382 pages. Price, $2.00.

The New York air brake has been changed and improved to such an extent that an up-to-date treatise describing the brake fixtures and their operation is now desirable, and the demand has been well met in this volume. It has been compiled by prominent air brake inspectors and experts, and is well illustrated by numerous colored diagrams. A good portion of the book is taken up with the examination questions and answers adopted by the Air Brake Association, and, while this may be desirable for use in the instruction car and for preparation for examinations, it might well be left to the separate pamphlet which is published by the association. The method of describing the brake by use of questions and answers is also questionable, as it often deviates too far from the simple description and a change from this old method is desirable.

Graphic Statics. By William Ledyard Cathcart and J. Irving Chaffee. Published by D. Van Nostrand Company, 23 Murray street, New York. 5 in. x 7¾ in. 183 pages. 54 illustrations. Bound in cloth. Price, $1.50.

The purpose of this book is to provide a brief course in graphic statics for mechanical engineering students. Treatment has been restricted to the properties and general uses of the force and equilibrium polygons, such as are met in actual practice; detailed examples have been included wherever possible. The book is divided into six chapters, which deal with polygons, trusses, stationary loads, live loads, center of gravity, moments of inertia and friction.

Westinghouse Air Brake System. A Detailed Description and Explanation of the Operation of the Westinghouse Air Brake. Compiled and edited by leading air brake experts. Fully illustrated with colored charts. Frederick J. Drake & Company, Chicago. Cloth, 5½ in. x 8 in., 475 pages. Price, $2.00.

It is questionable whether it is worth while to include descriptions of the older forms of the air brake in a work of this kind, as much of it has become obsolete on many lines. The questions in the catechetical form occupy a large space in the volume which, in many instances, could be omitted and the description be given directly, thus saving considerable space. The examination questions and answers are already printed in the pamphlets of the Air Brake Association, and a more satisfactory book and one less bulky would omit that portion. For those who desire all the information describing the Westinghouse brake and its operation, as well as the examination questions, in one volume, this is the most satisfactory treatise thus far published. It is very complete and up-to-date, and is fully illustrated. The colored sections, which indicate the condition of pressure in various pipes, ports and chambers, will be found helpful to those who want to study the operation of the air brake. Among those who have assisted in compiling the volume are prominent air brake instructors and representatives of air brake companies, including Walter B. Turner, chief engineer of the Westinghouse Air Brake Company; L. M. Carlton, special instructor of the same company; Robert H. Blackall, air brake expert of the Delaware & Hudson, and C. B. Conger, air brake expert.

Bearings. B. L. P. Alford, editor *American Machinist.* Published by the *American Machinist,* New York. 6 in. x 9¼ in. 235 pages. Bound in cloth. Price, $2.50.

The author has endeavored to present the underlying principles involved in the design of all bearings and to show the application of the important types. The book is divided into two parts, the first part dealing with bearings in sliding contact, and the second with bearings in rolling contact. Sliding friction is taken up in its elements, and several tables of the co-efficients of friction of woods, wrought iron, cast iron, steel, bronze and other materials working on each other are given. The materials, allowable pressures, and speeds, and the design of journal bearings are considered in three separate sections. The design of flat and sliding surfaces and special bearings is considered in another section. Lubricants and information as to how bearings should be cared for are also included. Under rolling friction are considered factors of design, construction of ball bearings of different designs and the lubrication of these bearings. The book contains data and specifications which any engineer will find very valuable. We believe there is no other book published which treats the subject in such a comprehensive manner.

TIME FEATURE OF ENGINE FAILURES

BY ERNEST CORDEAL*

The almost universal system of comparing engine failure records by the number of failures, and the engine mileage between failures, does not provide the best and most accurate data attainable regarding this all important feature of locomotive operation. The difficulty lies in the fact that the item of greatest importance, that of the actual time delay to trains, is entirely ignored. Any delay in the movement of trains means an increase in operating expense and a decrease in the net earnings, and these increases and decreases grow immeasurably with the increase in the time of such delays. A passenger train five minutes, or a freight train ten minutes late, into a terminal cause only a nominal inconvenience and expense, while the same trains arriving one hour late are accountable for a loss of hundreds, even thousands of dollars, depending of course on the effect of such delays on the movement of other trains and on the nature of their lading.

A record of the actual number of engine failures and their exact cause is of inestimable value to mechanical department officials, as it provides accurate data on which they may base changes in design or reinforcement of weak parts on the locomotives, thereby tending to minimize the occurrence of delays due to power conditions. However, any comparison which may be made from data comprehending only the number of failures and mileage will not reflect the true bearing of this item on the efficiency of operation.

If the time feature were eliminated from the railway problem, its simplicity would be ridiculous, but such a state of affairs would presuppose a condition of apathy on the part of the traveling and shipping public which would render railways unnecessary. The presence and growth of the railway is due to its ability to transport the greatest weight the longest distance in the least space of time. When air navigation has been perfected to such a degree that the mails can be safely handled more expeditiously than at present, the roads will lose the mail contract, next will go their express and passenger traffic, and it is within the range of possibility that air transportation may eventually reach a stage where the railways will occupy the relative position in the transportation world held by the ox team of today.

In order to keep the railway from oblivion, resulting from incompetency, as long as possible, everything must be sacrificed to time. When washouts occur the track must be restored in the least possible time regardless of cost; weather conditions must be fought to the limit to avoid delays; engines and cars must be repaired quickly; enginemen, trainmen and despatchers must be keyed up to the schedule; cost, efficiency and quality efficiency must be sacrificed, or at least made subservient to the greatest of all—time efficiency.

Why, then, if the saving of time must be the ultimate aim, should not the delayed time be used as the basis for computing the efficiency of locomotive performance as effected by power failures. The fact that a locomotive part is unable to sustain the strain of the service required is important from a mechanical standpoint; the fact that the locomotive possessing the weak part caused a delay to traffic has a far wider significance in its relation to the problem of conducting transportation. It may be contended, and with a certain amount of truth, that the number of failures and miles beween failures reflects a condition which may with a greater or less degree of accuracy afford comparisons between the performance of different periods, or between different classes of power, but would not a much more valuable comparison be offered if the time of delays as compared to the total time in service were used as a basis.

Take a specific actual case to illustrate the point in question. From two adjoining divisions operating over similar territory and using identical power the following figures show that division *A*, having a greater number of failures and a less mileage between failures had a less amount of time lost by trains due to power, and therefore, from a transportation standpoint, attained a greater efficiency than division *B*:

Division.	Engine Mileage.	Number Failures.	Miles per Failure.	Total time lost.	Total time in service.
A	91,055	7	13,008	18.5	9,248
B	71,463	4	17,866	24.3	6,873
Ratio of lost time to total time, division A.....					.02
Ratio of lost itme to total time, division B.....					.035

In this comparison the total time lost represents all delays not only to trains being handled by the engine failing, but also to other trains in being held at meeting points or connections where such loss of time was directly chargeable to the engine failing. The total time in service includes the time of all engines between terminals. It will be seen that division *A* had seven failures against four on division *B*, and that the miles between failures stood 13,008 to 17,866 in favor of *B*. Had the comparison stopped here, the impression gained would have been that the power on division *B* was better handled and in better condition than on division *A*. However, when the item of time lost is introduced, we find that the total time lost by trains due to the seven delays on division *A* was only 18.5 hours, or an average of 2.6 hours per failure; while the total time chargeable to the four failures on division *B* was 24.3, or an average of 6.1 hours.

In order to obtain a comparison of the time lost on a basis of the amount of business handled, it is necessary to introduce some other factor, and in this case the actual hours spent by all engines in service between terminals has been used. However, practically the same results would have been obtaind by using the engine mileage. The furnishing of data necessary to make comparisons of this kind possible would not impose a burden on the clerical forces, as all of the information required is already compiled for one purpose or another, and the mere process of collecting and correlating the figures would demand but a nominal amount of labor.

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REMOVING A STUCK WEDGE

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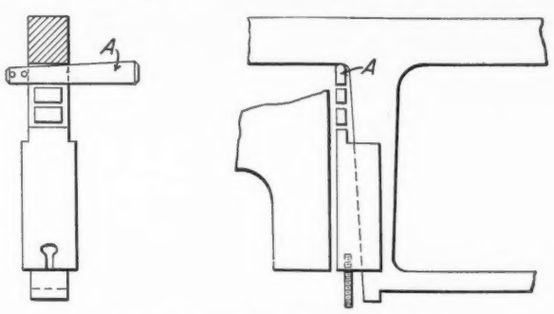
Many times with the limited tool equipment in the average engine house the proposition of removing a stuck wedge is a most difficult one. The accompanying illustration shows a method of removing such a wedge by means of a rod key *A* and some small pieces of flat bar iron cut so that they may be dropped between the driving box and the face of the frame jaw. The



Taper Key Used for Removing Wedges.

driving wheel may be stopped so as to allow the key to be inserted between the spokes. As the wedge is driven down by forcing the key in, a piece of iron may be placed in on top of the wedge and the key used over again. The circular side of the key fits the fillet in the top corner of the frame jaw and prevents it from turning as it is driven in with a sledge.

ELECTRIC WELDING IN RAILWAY SHOPS

A Number of Typical Jobs Are Illustrated and the Costs Are Compared With the Older Methods. The Process and the Apparatus Are Then Described and the Advantages of Electric Welding Are Outlined.

BY O. S. BEYER, Jr.

A process of autogenous welding by electricity, patented and known as the Siemund Wenzel process, has recently been applied in several railway repair shops. For several years it has been used in steamship, boiler and machinery repairs, and its success in marine repair work naturally suggested its use on railways. Today, but eight months from the time a complete welding outfit was first installed in the Hornell shops of the Erie Railroad, its success has been so marked that it bids fair to become as standard a railway repair device as pneumatic tools, wheel and crank pin lathes, flue welders, cylinder borers and other tools characteristic of railway shops. The extent to which the process finds successful application is very great. On steamships, where it was first used, such highly stressed parts as boiler and furnace sheets, shafts, stern frames and rudder posts have been repaired. Its use in the railway repair shop is not confined to locomotive boilers and fireboxes, but is extended to machinery, cylinders, wheels and even to driving tires. Defective and worn parts of stationary boilers of both the fire tube and water tube types have been repaired. Broken machine tool parts have been reclaimed. Indeed, its application is suggested wherever machinery of any kind is used and maintained.

Fig. 1—Mud Ring Partially Welded After Being Drilled and Chipped Out.

Fig. 2—It Was Necessary to Remove More of the Defective Mud Ring After Being Partially Welded.

The illustrations show a few examples of electric welding done at the Hornell shops of the Erie Railroad. Figs. 1 to 4 show the different stages of welding the mud ring of a standard consolidation locomotive. The mud ring was broken through at the left front corner. If repaired in the old way it would have been necessary to remove and weld it in the blacksmith shop. The mud ring was drilled, chipped and welded out to its original size by filling in 74 cubic inches of metal. The work had been partially completed, as shown in Fig. 1, when another defect was discovered and it became necessary to drill and chip out another section of the ring, as shown in Fig. 2. The finished job is shown in Fig. 3. A view of the finished weld on the inside of the firebox is shown in Fig. 4. In connection with the mud ring repairs the seams around the right front and left back corners of the mud ring were welded. A patch under the fire door opening, Fig. 5, was also welded around its edges in place of calking. The comparative costs for repairing this mud ring by the old method and the electric welding method are as follows:

Old method—stripping engine, removing mud ring, welding mud ring, preparing mud ring for re-application, re-applying removed engine parts, all material and labor complete; labor prices based on prevailing piece work prices.....$118.06

Electric welding process—Preparing, welding, finishing, material, labor and electric current, complete..... $32.07

The application of electric welding in firebox repairs is shown in Fig. 6. The longitudinal seams between the side sheets and crown sheet of the firebox were so wasted away by calking that the engine was sent to the shops for a new firebox. The seams were welded their entire length, approximately 6 ft. 10 in., by applying metal averaging 3 in. in width and ⅜ in. in thickness. Had the engine received a new firebox, it would have been necessary to strip it and remove the boiler to the boiler shop. The cost of applying a new firebox, as compared to welding the seams by the electric process, is as follows:

Application of new firebox—Stripping engine, transferring boiler, laying out firebox sheets, building and applying firebox, applying staybolts, crown bolts, mud ring, etc., overhauling flues, riveting and calking, refitting engine; all labor and material, complete $777.18

Welding seams and defects by electric process; all labor, material and electric current complete..... $56.40

Another example of electric welding on a locomotive firebox is shown in Figs. 7 to 10. The sheets of this firebox were cracked along the mud ring and a patch on one side was so

wasted away that it would have been necessary, had the electric welding process not been available, to renew the entire box. Fig. 7 shows the defects in the sheet at the left corner of the firebox. The white line indicates where the sheet would ordinarily have been cut out and a new patch applied. Fig. 8 shows the cracks which were welded near the left front corner of the mud

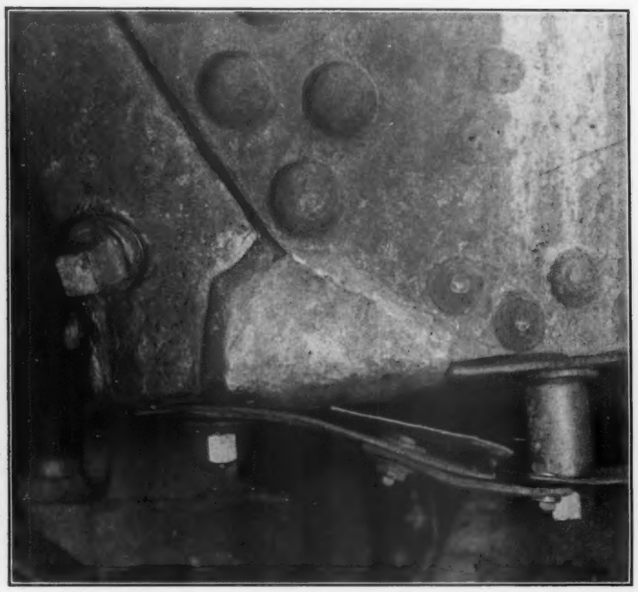


Fig. 3—The Finished Weld on the Mud Ring and Sheet.

ring, the rough surface of the weld having been chipped off and finished. The right back corner of the firebox after the cracks were properly welded is shown in Fig. 9. Had it been necessary to renew the entire firebox the cost would have been as follows:

New firebox complete, all work and material.....$800.68
Cost of electric welding which obviated the necessity for a new firebox, including material, current and labor complete..... $22.11

Fig. 4—Showing the Inside of the Firebox Where the Mud Ring Was Welded.

An interesting example of the welding on of a vertical firebox patch is shown in Fig. 10.

Figs. 11 to 13 demonstrate how this process is used in machinery repairs. The valve rod guide was cracked from the keyway out. The crack was chipped and welded by the electric process. Ordinarily the defective guide would have been scrapped and a new one forged and machined. Fig. 11 shows the crack chipped preparatory to welding. Fig. 12 shows the guide after it was welded, the weld not being dressed. Fig. 13 shows the job completed and the guide ready for service. A comparison of the cost for a new guide and the cost to reclaim the cracked one is as follows:

New guide, forged and machined, complete.....$5.53
Cracked guide, electrically welded and machined, complete..... $.83

An electric weld on the spoke of a cast steel trailer wheel center is shown in Figs. 14 and 15. This gives another idea of how and where the process may be applied with success. The wheel center in question was returned to service seven months ago and has not been heard from since. Fig. 14 shows the spoke chipped and V'd out, ready for welding. Fig. 15 shows

Fig. 5—Patch Under Fire Door with Edges Welded Instead of Calked.

the spoke welded, but not dressed. The costs for doing this work by the old and the new methods are as follows:

Old method—Dropping wheels, transferring, removing tires, removing wheel from axle, cutting rim for expansion, making weld, replacing tire on wheel and wheel on axle and under engine, coupling up; all work complete, ready for service..... $10.30
New method—Preparing weld, labor of weld, material, current, and final dressing, complete $3.38

A rocker arm which was partly cracked around the bottom of the bosses is shown in Figs. 16 and 17. By the old process it would have been necessary to cut the ends of these arms off, forge new ends, and weld them to the rocker at the forge. With the electric welding process it was only necessary to chip out the cracks, weld them up by the new method, and machine down the bosses. Fig. 16 shows the bosses chipped and V'd out ready for welding. Fig. 17 shows the rocker electrically welded and machined, complete. The costs, old method and new, are as follows:

Old method—Cutting off old arms, forging two new ones, welding them on, laying out, machining bosses and arms; material and labor complete $6.13
New method—Preparing, welding; material, current and labor complete $2.93

Electric welding applied to locomotive cylinders is illustrated in Figs. 18 and 19. The left cylinder of a heavy consolidation locomotive is shown. Two cracks, one 9 in. and the other 8 in. long, running from the front edge inwards, were V'd out, both on the inside and the outside. They were then welded by carefully filling in metal with the electric welding process. Fig. 18 shows one of the cracks welded from the outside. Fig. 19 shows the inside of the cylinder, with the cracks completely welded and the cylinder finish bored. The welds may be seen distinctly and show the neat appearance of the work done by this method. Had the old method been used these cracks would have been dovetailed out and copper patches inserted, which would probably not have strengthened the cylinder as a whole. The electric welding process stepped in, and, besides repairing the defect, reinforced the cylinder at its weak spots. The cost to make the repairs by the older method is a little greater than by electric welding.

Old method—Prepare for patch, insert and dress; labor and material complete	$3.50
New method—Prepare for weld, weld by electricity, dress weld; labor, material and current complete	$2.90

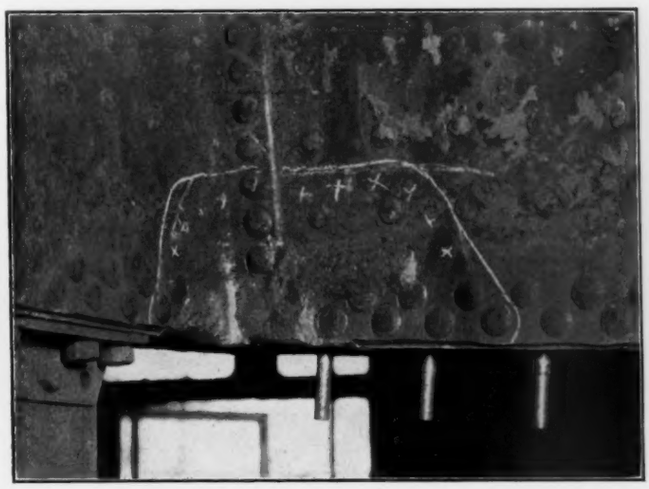


Fig. 7—Defective Firebox Sheets Repaired by Electric Welding.

Fig. 8—Repairs to Firebox Sheets Made by Electric Welding.

Part of a back flue sheet, three of whose flues were welded to the sheet for purposes of demonstration, is shown in Figs. 20 and 21. Fig. 20 shows the three flues securely welded to the sheet. Fig. 21 shows the flues after welding, chipping and trim-

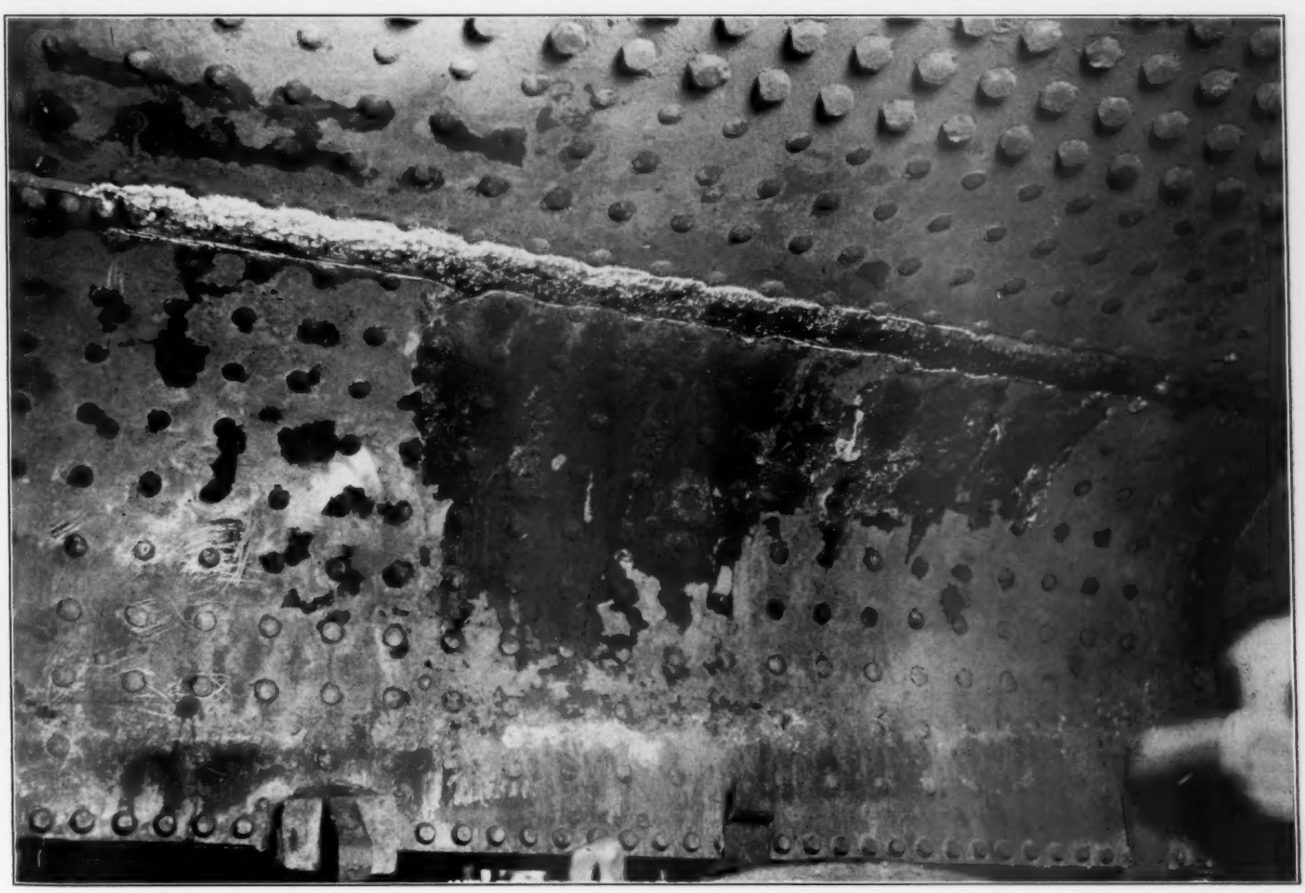


Fig. 6—A Longitudinal Seam, Over 6 ft. Long, Repaired by Electric Welding.

ming with a pneumatic hammer. Since this experiment has been made, complete sets of flues have been welded to the back flue sheets of several engines and the engines have been returned to service. Close observation of these engines indicate that the

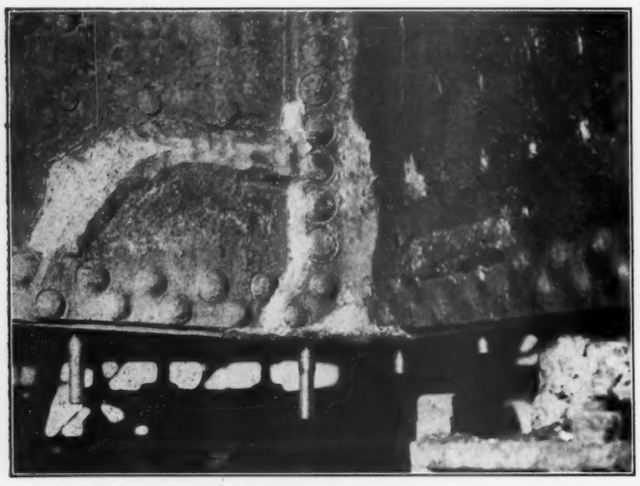


Fig. 9—Electrically Welded Crack in Corner of Firebox.

work in the engine house to keep the flues tight is considerably reduced. Three months' service of a few engines is too short to look for ultimate results. The indications, however, are that by the use of electric welding in flue applications, a step in advance in boiler construction and maintenance has been made. Add to this what will be gained by electrically welding all firebox and mud ring seams, while the boiler is being built, and the proper maintenance of locomotive boilers may be considerably simplified from its present perplexing state.

An electric welder at work on a flue sheet welding the flues and bridges is shown in Fig. 22. The welding clamp is held in one hand while the other holds a frame containing three thicknesses of ruby or green glass through which the operator observes his work. The electric machinery seen in the rear is a temporary installation, being a low voltage generator belt driven by a standard motor, all mounted on an improvised wooden base. A typical installation will be illustrated and described later.

Fig. 10—Side Sheet Patch Welded to Firebox.

DESCRIPTION OF PROCESS.

The system is of the arc type. It employs direct current supplied at potentials of 20 to 30 volts at the arc and 50 to 80 volts at the generator terminals. One lead of the welding circuit is attached to the welding clamp which holds the welding material —pencil or electrode. The current is furnished by a generator usually direct connected to a motor, properly wound for the current and line voltage available at the place of installation.

An electric arc about 3-16 in. to ¼ in. long is sprung between the welding material or pencil, and the object to be repaired. The voltage is regulated until the current is of the proper amount to suit the work in hand. The spot on the surface of the object being welded, where the electric arc strikes, is instantly brought up to a state of incipient fusion, and minute molten

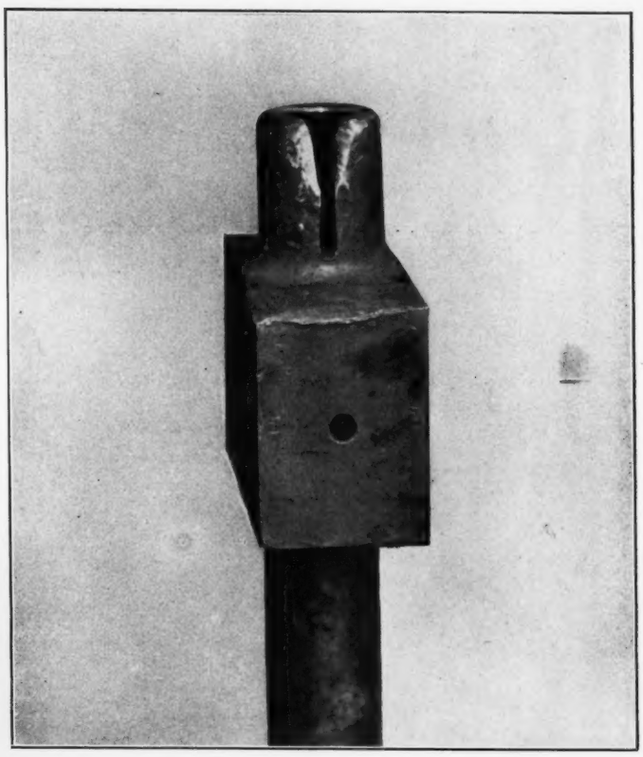


Fig. 11—Crack Chipped in Valve Rod Guide Preparatory to Welding.

particles of the pencil or electrode detach themselves progressively in a continuous rapid stream, and, following the arc, attach themselves securely at the spot where the arc strikes. This proceeds very uniformly until either the arc is interrupted or a sharp fluctuation in current takes place.

About every minute or so the actual welding operation is stopped while the operator subjects the local heated area of the weld which he is making to rapid blows from a small hand hammer. The object of this is primarily to force out any minute portions of oxide or slag that may have formed due to the presence of impurities or improper manipulation. It is also done with the object of working the metal of the weld, and to close up any small pin holes that may have formed. The repairing material is applied until the chipped and V'd out portion is entirely filled up, and then an additional amount is applied for reinforcement. This works out very satisfactorily since the additional material added adheres as securely as the material which is part of the direct weld, and thus serves to reinforce in direct proportion to the section of the material added. Consequently there is no reason why a weld thus reinforced cannot be made as

strong, or even stronger, than the original material. In practice it is found desirable to reinforce welds of this nature sufficiently to make their tensile strength about equal to the tensile strength of the original material.

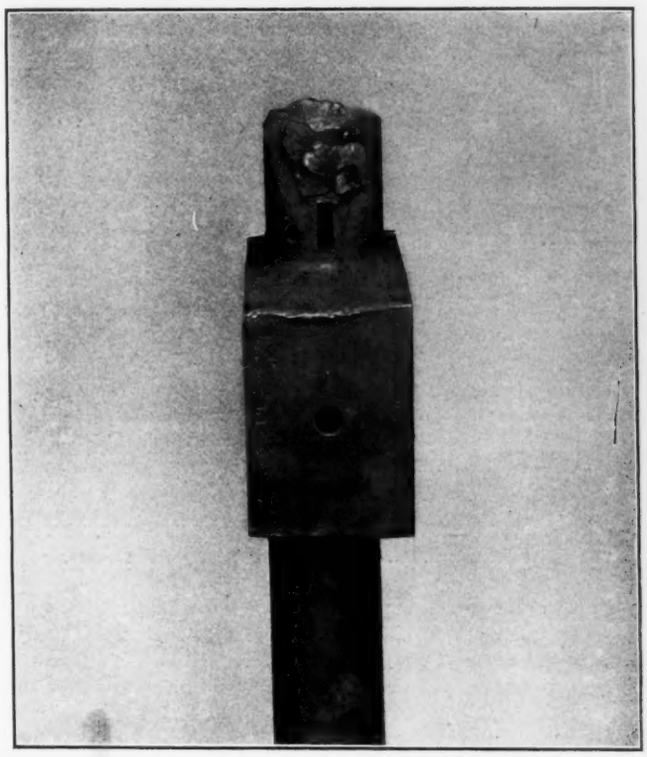


Fig. 12—Valve Rod Guide After Welding.

The arc and the molten particles of material are guided by a magnetic flux which originates in the electrode holder. The welding current is led around the handle of the holder through a heavy series coil in such a way that a strong magnetic current is set up which travels through the pencil and in the direction of the arc. The presence of this magnetic current assists greatly in causing a very rapid deposition of the repairing material and makes overhead welding possible and perfectly practical. Without this magnetic current, overhead welding could not be done with any degree of certainty as to the results. The

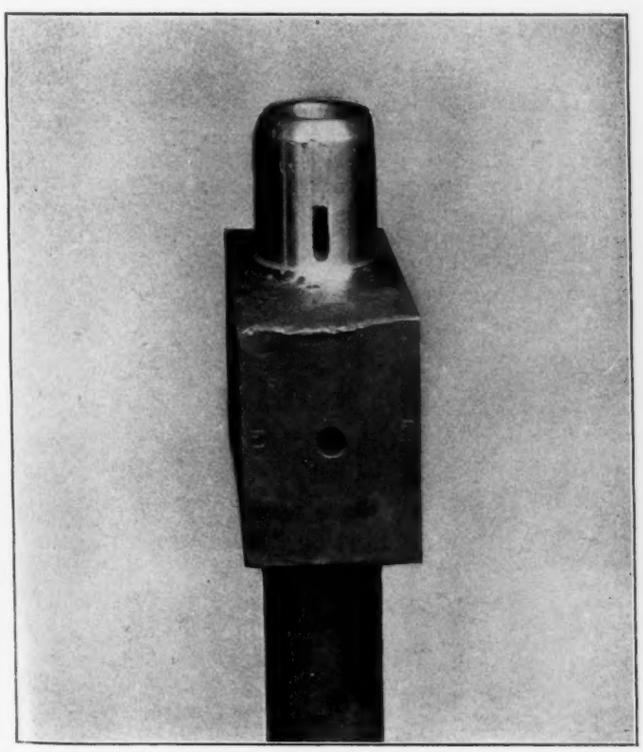


Fig. 13—Welded Valve Rod Guide Ready for Service.

Fig. 14—Cracked Wheel Spoke Chipped Preparatory to Welding.

Fig. 15—Trailer Wheel Spoke Welded But Not Dressed.

magnetic current also increases the strength of the weld owing to its concentrating influence and the cooling effect on the arc. It prevents oxidization of the molten particles while in transit and the formation of slag and pin holes that sometimes form in the weld.

The welding pencil consists of a very pure grade of Swedish iron of a definite cross sectional area. It has been determined by careful laboratory research that the quality of the repairing material and the pencil diameter have a decided influence on the properties of the weld. A definite relation exists between the size of the pencil, the amount of the current, and the tensile strength of the weld. Hence the quality of the material and the size of the pencil must be carefully selected.

In order to prevent oxidation and the consequent formation of slag, and also to provide certain ingredients which affect the welding material chemically and so benefit it physically by making it soft and ductile, the welding pencil or electrode is covered with a flux. When the welding operation is carried on, the flux melts and vaporizes, enclosing the molten particles and the arc to the exclusion of atmospheric oxygen which attacks the repairing material in its fused state, and thus improves the quality of the weld.

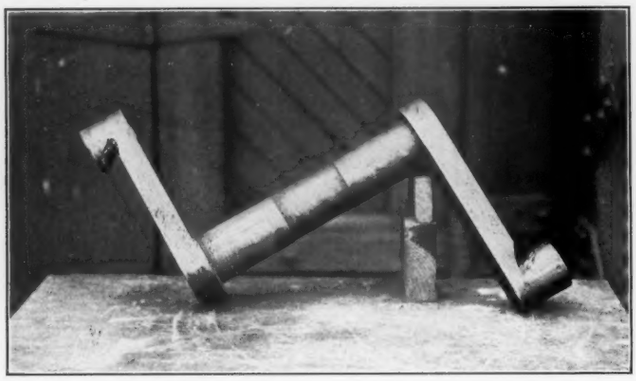


Fig. 16—Cracked Rocker Arm Chipped for Welding.

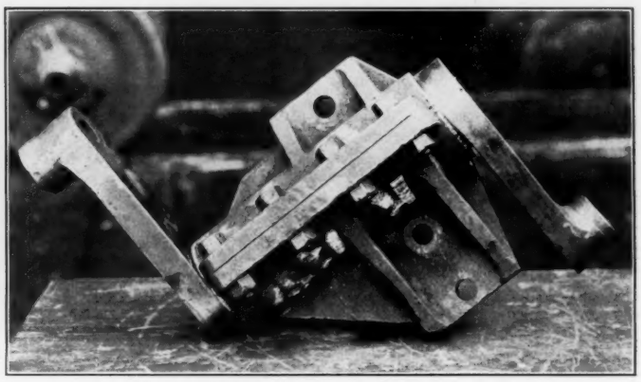


Fig. 17—Rocker Arm Repaired and Ready for Service.

DESCRIPTION OF APPARATUS.

An electric welding installation consisting of a motor generator set, the necessary control apparatus, measuring instruments and protective and steadying resistances, is shown in Fig. 23. This outfit is in use in a railway shop. The motor generator is provided to convert the standard current available into direct current at voltages suitable for welding. Hence the motor may be either of the direct or the alternating current type. The generator is wound to furnish a maximum constant output of 200 amperes direct current at a range in potential of 50 to 80 volts. This range in voltage is secured by varying a resistance in series with the field circuit. A variable rheostat for this purpose is mounted on the slate switchboard so that it may be conveniently manipulated by the operator.

A second resistance is placed in one leg of the welding circuit in such a position that when the generator is short circuited at the instant of striking the arc the resistance acts as a protection to the armature and commutator of the generator by limiting the

Fig. 18—Outside of Cracked Cylinder Which Had Been Repaired by Welding.

Fig. 19—Inside of Cracked Cylinder Which Had Been Repaired by Welding.

maximum current possible at a maximum voltage to the greatest permissible instantaneous overload capacity of the generator. Another resistance is provided which is automatically thrown in

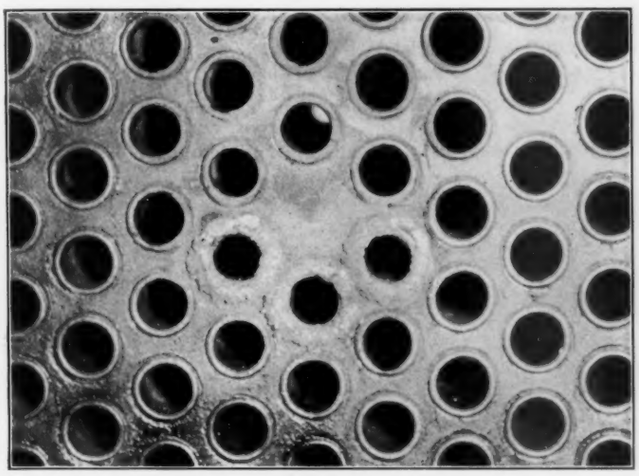


Fig. 20—Three Tubes Welded in Flue Sheet.

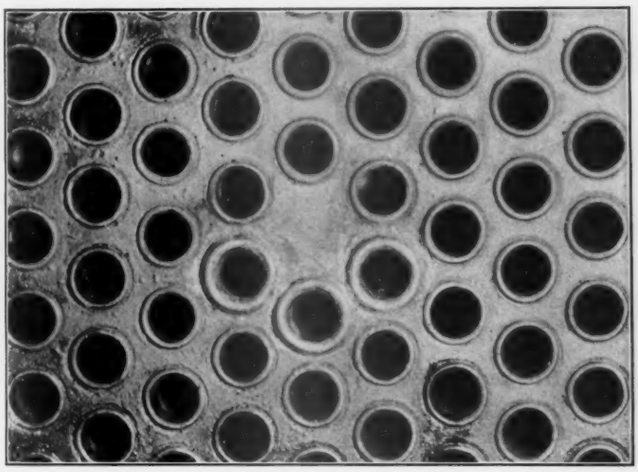


Fig. 21—Welded Tubes After Being Chipped and Trimmed.

series with the above resistance and across the terminals of the generator the instant the welding arc is interrupted. Together these two resistances serve as a secondary or temporary load on the generator when the welding operation has ceased. The instant the welding is started again, this latter resistance is automatically cut out. These two resistances are so proportioned that the load which they impose upon the generator equals the load imposed upon the generator when the welding operation is under way. In this way violent fluctuations of the load on the

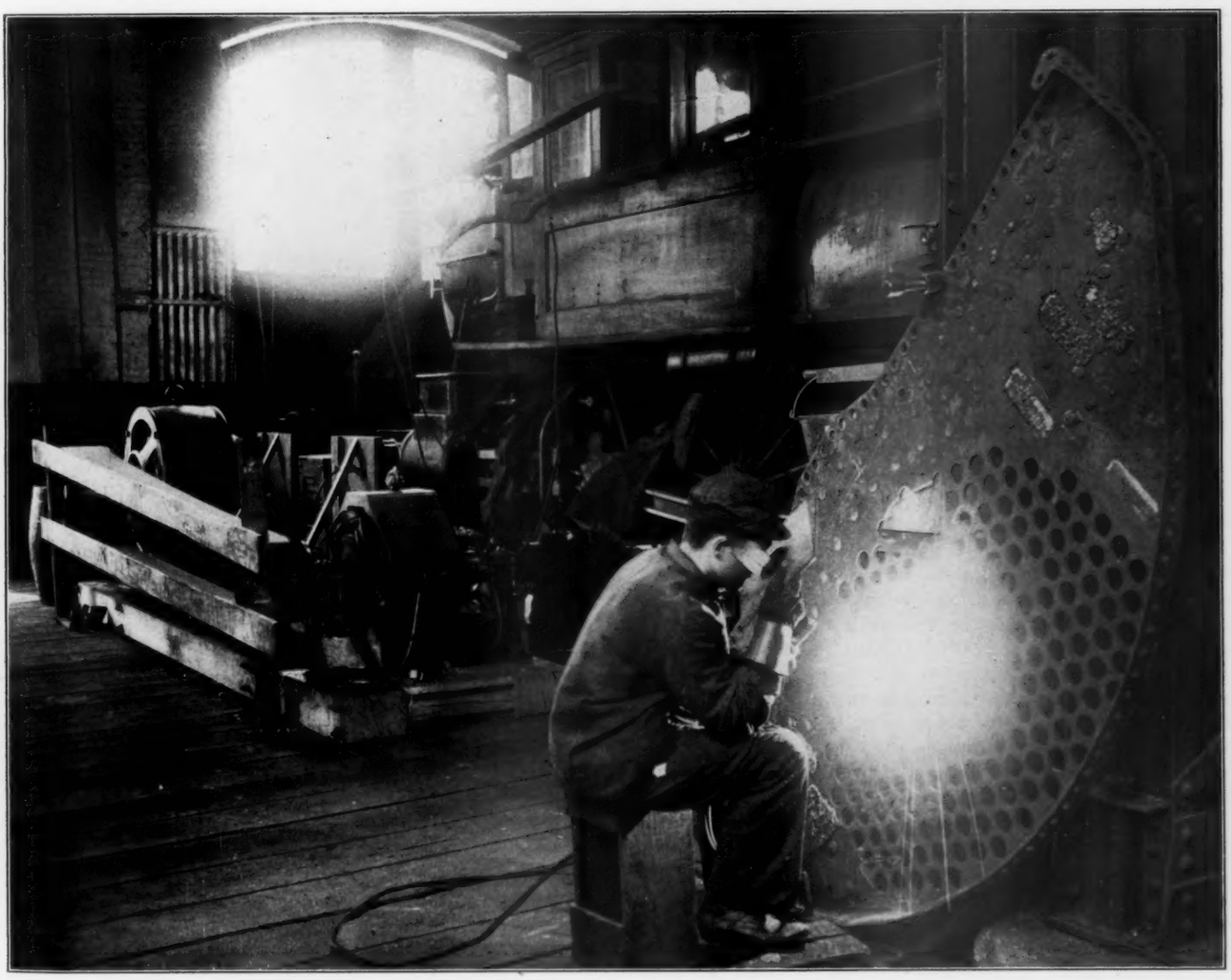


Fig. 22—Electric Welder at Work; Electrical Machinery in the Rear Is a Temporary Installation.

motor generator are avoided. Furthermore, this particular arrangement results in the best welding work. The closer the regulation and the more constant the generator voltage the less the likelihood of pin holes and defects in the weld.

An ammeter and a voltmeter, which are both connected to the welding circuit, are mounted on the switchboard. These instruments serve the purpose of indicating the amount of current and the voltage of the welding circuit. The welding clamp or holder consists of a wrought iron handle, properly insulated, around which is wound a coil. This coil in turn is insulated from the hand by a leather covering. To one end of the coil is attached one of the leads of the welding circuit; the other end of the coil is attached to the holder near the base of the clamp. The clamp consists of a projection from the holder and a piece of spring steel, so fastened together that the combination serves to hold the welding pencil or electrode rigidly. The entire welding outfit, except the holder and welding leads, is mounted on a substantial base, which in the case of the illustration is made up of standard rolled steel sections. For the machines now being built, this base is of cast iron with suitable projections on the back to which are fastened the banks of resistance which are part of the installation. The slate switchboard with its terminal lugs, fuses, switches, motor starting box, electrical measuring instruments, contactors and relay, is mounted on an angle iron frame securely fastened to the bed of the motor generator set and the machine housings. In this way a firm and compact arrangement is secured.

An electric welding installation, such as described above, is capable of furnishing sufficient electricity for one welder at a time. The welding lines are brought from the switchboard to any place desired in the shop. In fact, a main, or several main welding circuits may be installed throughout the shops with occasional taps so arranged that it is only necessary to attach limited lengths of flexible welding cables to the main circuit at the taps and run these to the places where the welding work is to be done.

ADVANTAGES OF ELECTRIC WELDING.

From the foregoing it is obvious that autogenous welding by electricity has many advantages. The simplicity of the process at first sight is its most striking feature. The art of electric welding is not difficult to learn. Welders who can turn out work with uniform success can be made in three to four weeks. The hardest thing to acquire is the ability to maintain the arc steady and keep feeding the electrode uniformly. When once this is learned, together with the way to adjust the apparatus, the welds secured will be successful.

Another feature which is greatly to the advantage of the electric welding process is the entire absence of danger from explosion and fire. There is nothing whatever to explode, and the low potential of the welding circuit, together with the protective resistances and the fuses in the welding circuit leads, reduce the fire dangers from faulty insulation or short circuiting to nothing. The fact that the voltage is so low makes this process absolutely safe to handle by the welder, considered from all view points.

The wide range of application of the process is another one of its distinct advantages. It may be used to do very heavy as well as light work. Its success in this direction has been proved more by its extended application in the repair of heavy machine parts and the framing of ships than by its application to locomotive repairs. To date it has hardly been sufficiently extended in locomotive repair work to demonstrate the limits of its possibilities. However, if highly stressed parts of ships can be repaired by this method, there certainly is no reason why the same thing will not hold true in locomotive repairs. New work is being done daily, which it had never been considered possible to do, and success is invariably the result.

By the use of the electric welding process it is possible to deposit an additional amount of metal on the part being welded so that it will act as a reinforcement to the weld proper.

As pointed out in the description of the process, the electric arc is narrowly confined and only heats a very limited area on the surface of the object being repaired to incipient fusion. This heating is instantaneous, taking place immediately when the arc is struck. Thus the heat incidental to the welding operations, though intense, is extremely localized, being just sufficient to fuse a small spot to which the molten particles from the welding pencil attach themselves. It is not necessary to preheat a large surrounding portion so that a sufficient amount of heat is stored up in the adjacent material. Owing to this very marked characteristic—the extreme localization of the heat—no cooling strains

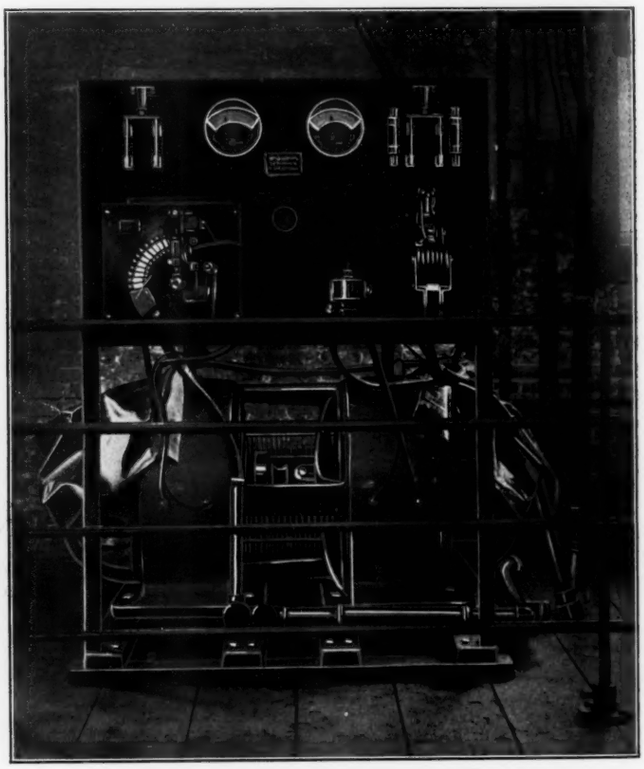


Fig. 23—A Typical Electric Welding Installation.

are set up around the weld after the work is done. Hence there are no subsequent failures from cracking or buckling at the weld or in other parts of the object repaired. It is due to this particular feature that the success of this process, wherever applied, has been so uniform.

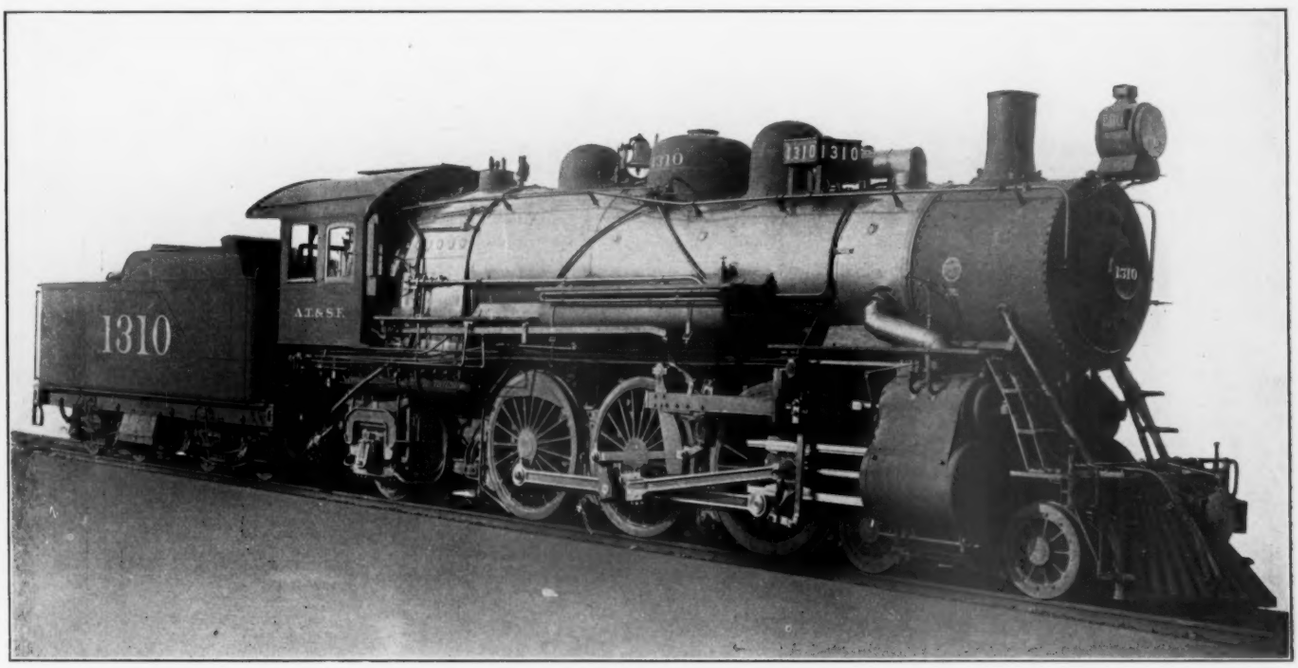
The character of the weld itself, it being soft, ductile, and free from slag and oxides, as well as injurious carbon compounds of iron, makes the electric weld secured by the Siemund Wenzel process the most perfect secured by any system of autogenous welding. The close regulation of the current guards against injuring the original material adjacent to the weld. This, too, benefits the weld as a whole. The convenience with which overhead welding may be done is another decided advantage. The magnetic current created in the welding holder makes this possible. Overhead welds are made just as fast as welds in any other position and are equally as strong.

Owing to the comparatively small amount of power required, the simplicity of the entire installation, the fact that the machinery used is practically of standard design and manufacture throughout, embodying no untried features of construction, the rapidity with which the work is done and the absolute uniformity of the success of the work, as well as the wide range of its application, make this process the cheapest and best with which to do autogenous welding. The results secured certainly justify this conclusion.

BALANCED COMPOUND 4-6-2 LOCOMOTIVES

After Several Years' Experience with Balanced Compound Locomotives of Three Types—Prairie, Pacific, and Atlantic —the Santa Fe Has Ordered 28 More of the 4-6-2 Type.

To meet the requirements for passenger power in districts where the grades are heavy, the Atchison, Topeka & Santa Fe has developed a Pacific type locomotive which includes a number of interesting features. In designing this locomotive, the aim has been to adhere to the general principles of the older power as far as practical and yet to introduce sufficient modifications to overcome the weaknesses which had been detected. This has not only tended to retain locomotives with which the men are familiar, but also has provided an opportunity to develop new power with the introduction of a minimum number of new parts. In designing the new engines patterns were selected almost exclusively from those common to the older locomotives.



This Design Is Based on a Long Experience with Balanced Compound Locomotives of Three Different Types on the Santa Fe.

Satisfactory service rendered by balanced compound Atlantic, Pacific and Prairie type locomotives, together with the requirement for a power at high speed greater than that given by the Atlantic type, led to the adoption of the balanced compound Pacific type. The first six-coupled locomotives with balanced compound cylinders placed in service on the Santa Fe were of the Pacific type.* All four cylinders of these older locomotives were arranged in the same horizontal plane and the engines were equipped with bifurcated high pressure main rods spanning the front driving axle. The valves were operated by the Stephenson motion, with eccentrics on the third driving axle.

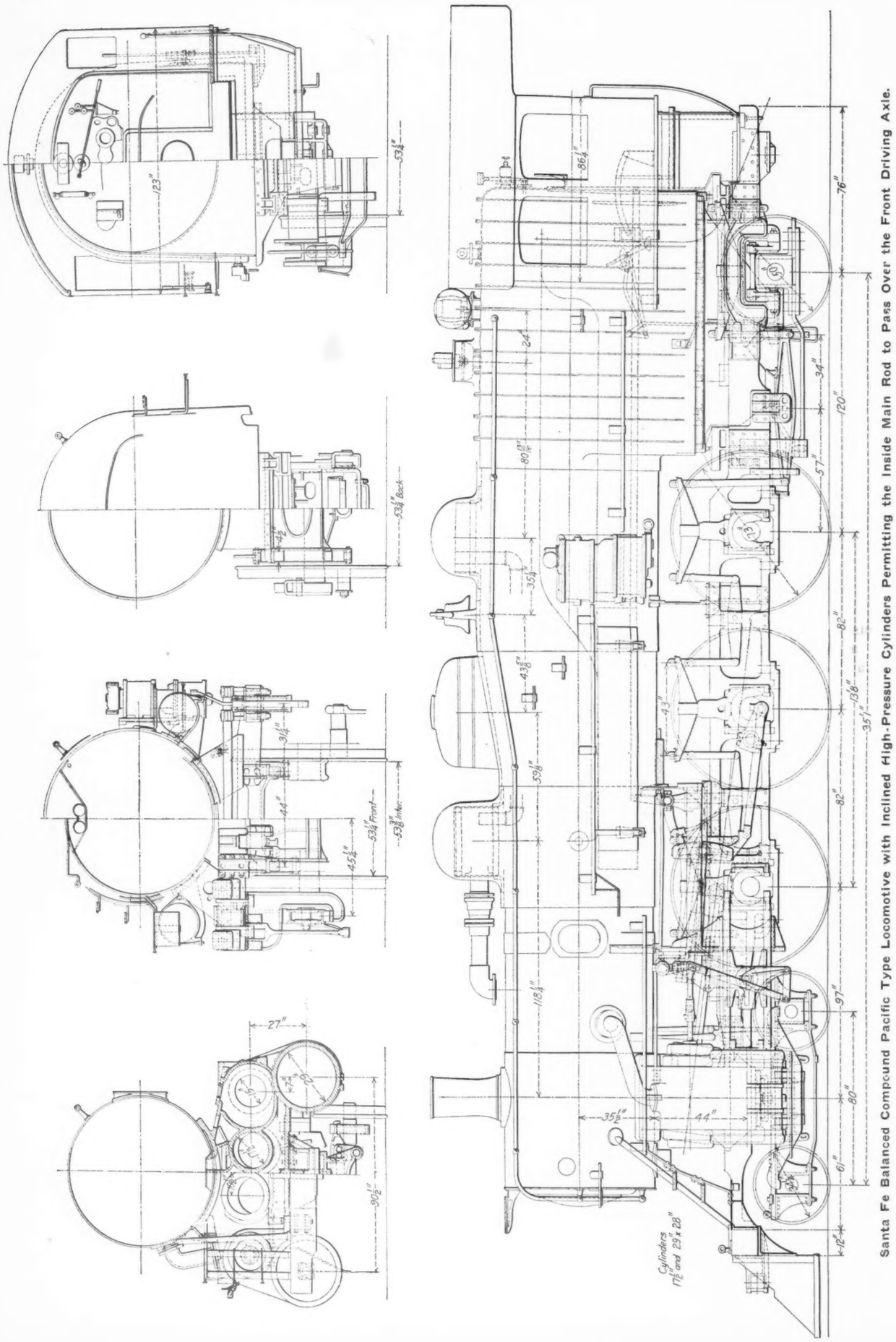
A few years later a different type of six-coupled locomotive with balanced compound cylinders was placed in service. This was a Prairie type† locomotive for fast freight. In the locomotives of this type the inside or high pressure cylinders are inclined and raised to a sufficient height to permit a straight main rod to clear the front driving axle. The steam distribution is controlled by the Walschaert valve motion, actuated from the outside main crank pins. The cylinder, main rod and valve motion arrangement of the Prairie type rendered such service as to commend them for application to the Pacific type, thus retaining the desirable features of the former balanced compound Pacific type, and at the same time eliminating the undesirable feature of the bifurcated high pressure main rod.

Retaining these features because of satisfactory results in continued service, the design of the last lot of locomotives was developed by the selection of parts common to the existing engines and principally from the two types already mentioned. The design was prepared under the direction of the superintendent of motive power. Most of the improvements had been introduced from time to time in revising and repairing existing engines, and therefore had been given the test of service before being embodied in the new engines.

Twenty-eight of these new Pacific type locomotitves have recently been built by the Baldwin Locomotive Works. Each locomotive develops a tractive effort of 35,000 lbs. The boilers of 22 are fitted with Buck-Jacobs superheaters of the latest design, in which the superheating chamber is built into the boiler shell, and all of them have Jacobs-Shupert fireboxes. Six of the locomotives are equipped for burning oil, while the remaining 22 burn coal. Of these, seven are arranged for burning Gallup coal, a light coal similar to lignite, mined in western New Mexico. In order to determine the relative merits of fire tube and drum type superheaters, three of the oil burners and two of the bituminous coal burners are fitted with Schmidt superheaters.

Each pair of cylinders is cast in one piece with a half saddle and a common piston valve, the center of which is 7 in. inside the low pressure cylinder center. The valve is arranged for inside high pressure admission and outside low pressure admission, and is of the type commonly used by the builders with bal-

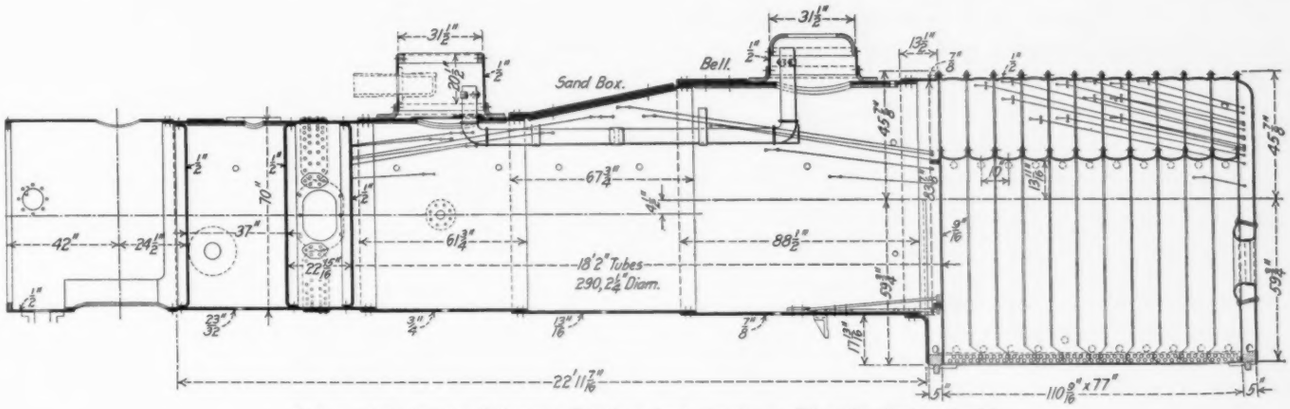
*See *American Engineer*, December, 1905, page 454.
†See *American Engineer*, November, 1906, page 434.



Santa Fe Balanced Compound Pacific Type Locomotive with Inclined High-Pressure Cylinders Permitting the Inside Main Rod to Pass Over the Front Driving Axle.

anced compound locomotives. The steam pipes are on the outside, where the joints are accessible for inspection and repairs, and where possible leaks will not affect the steaming of the engine. This is in accord with the latest practice of the Santa Fe, and is of the same general arrangement as applied to locomotives delivered on recent orders. The high pressure cylinders are 21 in. apart, measured transversely, and are set on a slope of 7½ deg. Their location makes it impossible to run the front and back flanges which take the cylinder bolts the full depth of the web and forged steel discs. Owing to the inclination of the inside cylinders, the inside and outside cranks on the same side of the locomotive are placed 187½ deg. apart.

In the valve motion the links are carried on longitudinal bearers outside the leading pair of driving wheels, and rockers are used to transmit the motion from the combining levers to the valve rods. The rocker boxes are supported on the guide yoke, and the valve rods, which are necessarily short, are provided with knuckle joints. The rockers and all pins used in the gear

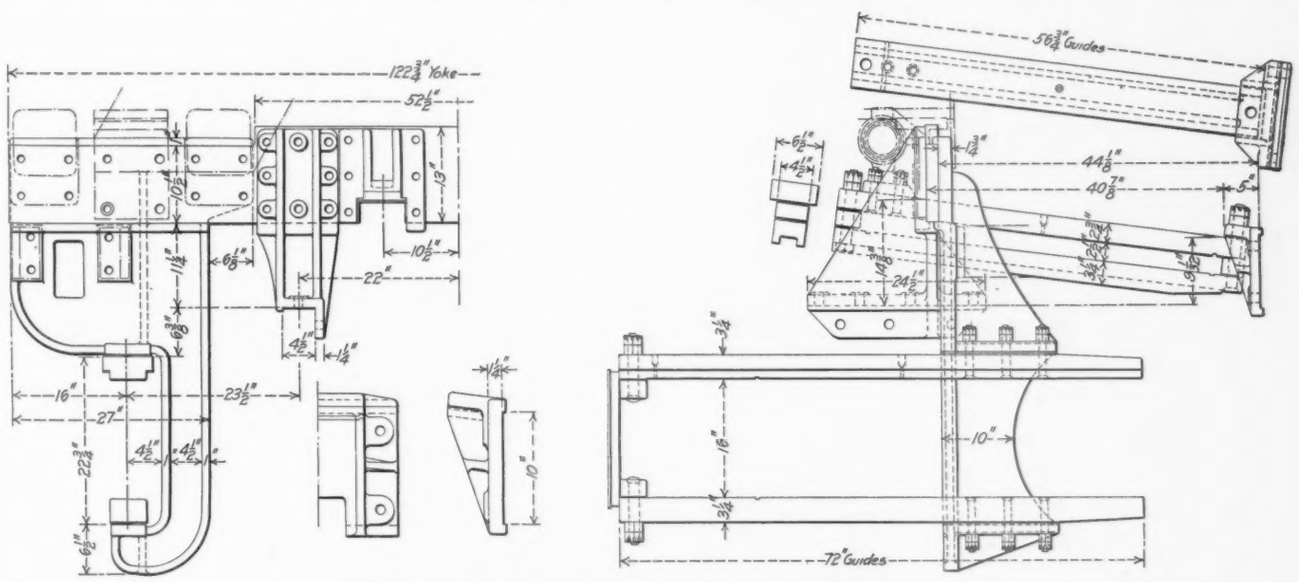


Boiler with Jacobs-Schupert Firebox and Auxiliary Throttle Valve Dome.

casting; to strengthen the joint, lugs are cast on the top of the saddle at the front and back, and two 1⅝-in. bolts pass through each lug. The opening in the smokebox is cut out sufficiently to clear the lugs.

The outside, or low pressure, guides are of the usual two-bar type, and are supported on cast steel bearers, which are bolted to a transverse yoke. The inside, or high pressure, guides are of the Laird type, this design being used in order to provide the necessary clearance above the leading driving axle.

work in bushings of Hewitt metal. The valves are set with a lead of 3/16 in. on the high pressure ports, and 5/16 in. on the low pressure. The details of the valve gear parts are among the many features which the Santa Fe has improved to overcome some of the annoying failures which often result from negligence of small parts. Care has been taken to avoid offset bearings in order to minimize the tendency to twist or buckle. All pins are made of ample size and are arranegd in double shear. Standard castle nuts are used throughout the valve gear.



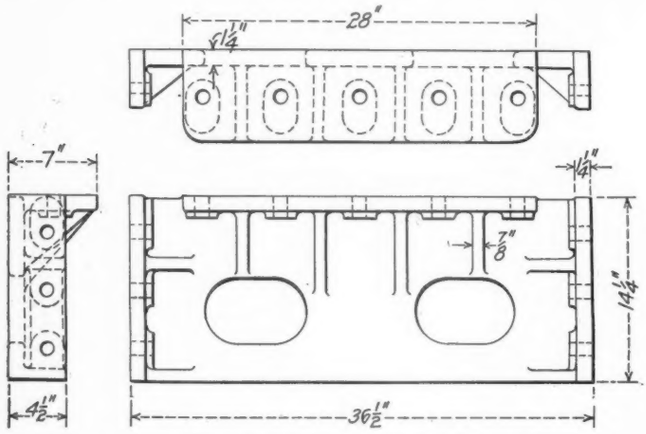
Guides and Guide Yoke—Santa Fe Balanced Compound.

Reference to the illustration will show that these guides are supported at the front end by the low pressure guide yoke, and at the back end by a cast steel frame brace, which is placed just behind the first driving axle and extends the full depth of the frame pedestals. The arrangement of the high pressure guides has resulted from the railway's experience in overcoming cylinder head troubles on older engines. The lengths of the inside and outside main rods are 100 in. and 110 in. respectively. The crank axle is of the built-up type, with a cast steel central

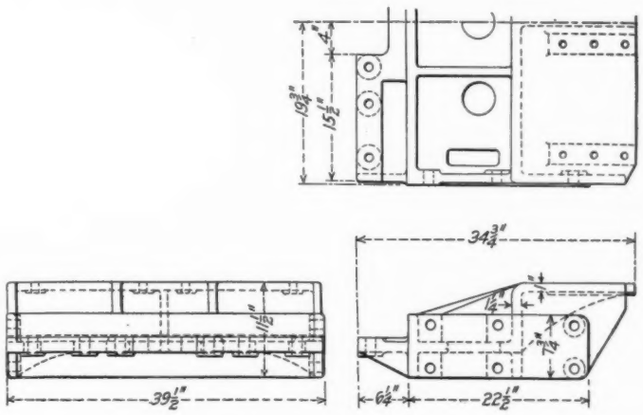
Lubrication of bearings is carefully provided for by large cavities made integral with the different members. No detachable oil cups are used on any part of the valve gear.

Carrying out the general scheme of adhering to its standard parts, the railway has provided a frame which may be used with its standard shoes and wedges, driving boxes, etc. The strength of the frames has, however, been increased as compared with previous engines and a more satisfactory system of transverse frame bracing has been introduced. The frames are

4½ in. wide, and are spaced 44 in. between centers. At the main driving pedestals they are offset ¾ in. on each side, thus increasing the distance between centers to 45½ in. This was done to provide sufficient room for the crank axle and driving journals. The same scheme was employed on the previous balanced 4-6-2 type. The frame rails are 6¾ in. deep over driving boxes. Between jaws the upper rail is 4¾ in. deep, and the lower rails are 3½ in. deep. The front frame sections consist of single rails, measuring 4½ in. by 10 in. in section under the cylinder saddle. They are joined to the main sections by specially designed connections. The rear frame sections are in the form of slabs, and are arranged to accommodate the trailing truck, which is of the Rushton type with outside journals.



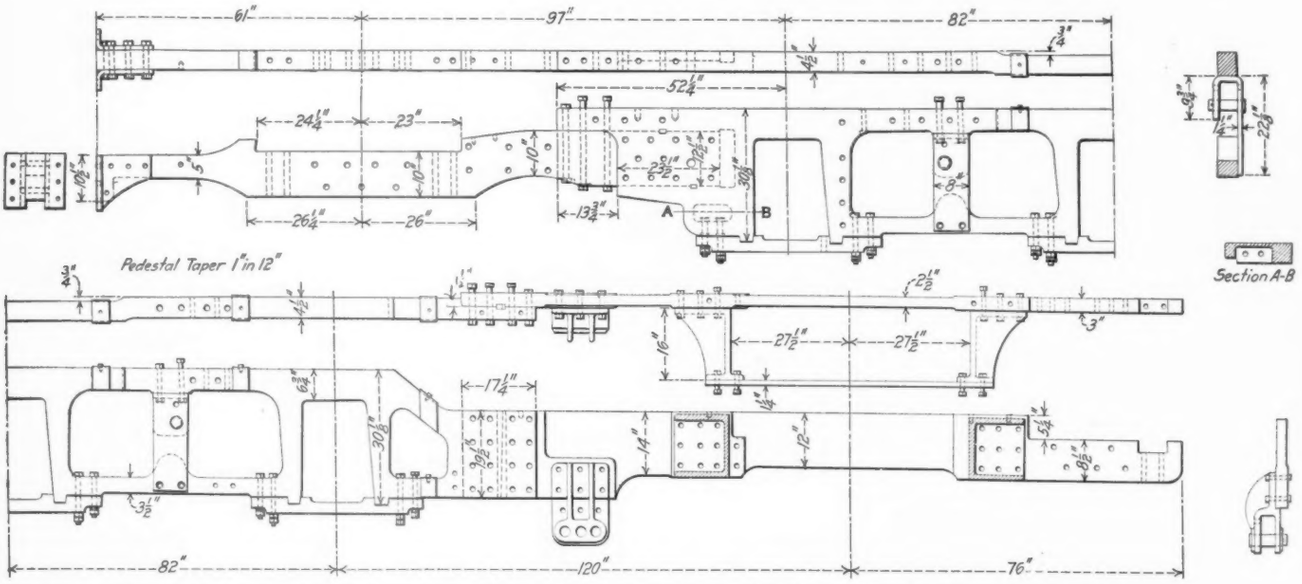
Frame Brace at Splice Between Main and Trailer Frames.



Frame Brace Just Back of Cylinders.

Close attention has been given to the transverse frame bracing as shown by the accompanying illustrations. A broad steel casting spans the front rails just back of the cylinders and is bolted to the cylinder castings. This tie also serves as a support for the driving brake cylinders. The main frame sections are provided with three cast steel braces. One is located just back of the front drivers with a bearing 37 in. in length on top of the frame. The same casting extends to the full depth of the pedestals to which it is securely bolted, additional metal being provided in the pedestals to include this bolting without weakening the frames. This brace also supports the back end of the inside guides. A wide and deep casting is located between the main and rear driving wheels, being bolted to both the top and bottom frame rails. Another brace is placed at the juncture of the main and rear sections of the frames. This tie is located immediately beneath the cast steel furnace bearer, to which it is securely bolted, thus making an unusually strong construction. The same arrangement of tie and furnace bearer is used at the back of the rear frame section behind the trailer truck. In addition to the frame braces described the frames are further stiffened by plates connected with proper ties to the belly of the boiler. These plates are secured at the lower ends to the steel frame braces.

The arrangement of the equalizing system and spring rigging calls for no special comment except for the equalizer between the rear driver and the trailer truck. The design was revised to place the bearings of all three pins in the same horizontal plane, thus eliminating the offset which tends to twist the equalizer.



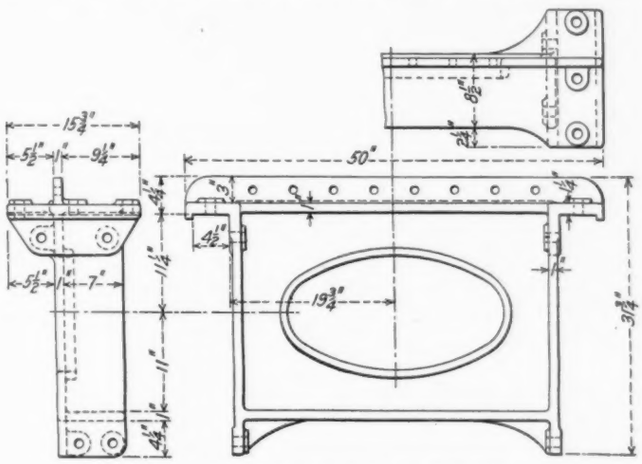
Frames for 4-6-2 Type Balanced Compound. The Offset at the Main Pedestal Is Indirectly Due to the Cranked Axle.

Another of the small details revised for the benefit of the new engines is the trailer truck oil cellar. In this the lower portion of the cover casting and the cellar are cast in one piece. This eliminates joints in the cellar which permit oil to leak out.

Wagon top boilers with two steam domes are used on all the locomotives. The rear dome is placed on the wagon-top, while the forward dome is located near the front end of the barrel. Steam is conveyed from the rear dome to the forward dome through a pair of 5-in. pipes. The forward dome contains

the throttle, and as communication between its interior and the boiler is cut off by a plate, the steam supply for the cylinders is drawn entirely from the rear dome, which is at the highest part of the boiler. The throttle takes steam through the top only, and communicates with the external dry pipe.

In the engines with Buck-Jacobs' superheaters, the superheating chamber is 37 in. in length, its forward tube sheet being 24½ in.



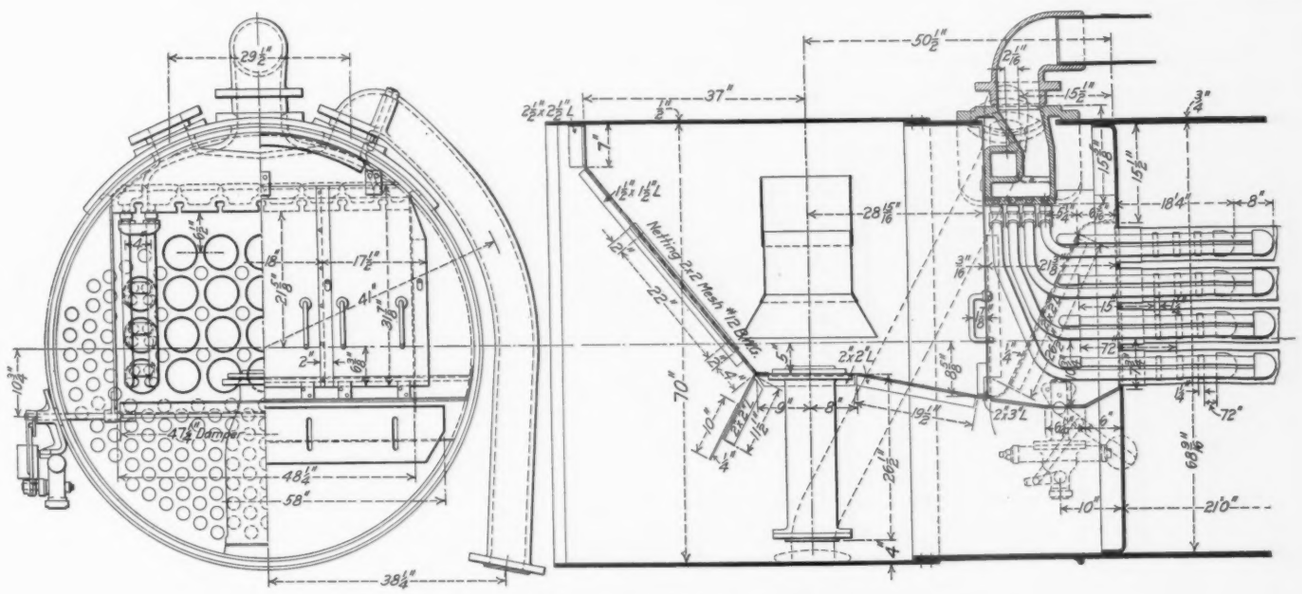
Frame Brace Ahead of Third Pedestal.

back of the center line of the stack. An intermediate chamber is placed between the superheater and the main evaporating section of the boiler, and as this chamber can be entered through a manhole the tube ends are easily accessible. The superheater tubes are welded into the tube sheet at the back end, and rolled at the front end. Steam enters the superheater on the top center line and is guided by internal baffle plates so that it follows a circuitous course among the tubes. The steam leaves the superheater through right and left hand pipes which run direct to the steam chests and have their joints outside the boiler. The superheater section of the boiler is butt-jointed to the main boiler section, the joint being secured by an external covering strip taking four circumferential rows of rivets. The superheater tubes are arranged in a manner which has proved most satisfactory, as far as superheating the steam and drafting the boiler is concerned. There are 350 2¼ in. and 67 3 in. tubes, and one large tube 6 in. in diameter. The latter is placed just above the center line of the heater and is applied to facilitate the removal of the boiler tubes. The 3-in. tubes are grouped in the lower part of the heater.

In the boilers equipped with Schmidt superheaters the front tube sheet is placed 50½ in. back of the stack center. A large opening is cut in the smokebox shell, immediately above the superheater header, and this opening is covered by a saddle-shaped casting. There are three openings through this casting. The center opening communicates with the saturated steam chamber in the header, and the side openings with the superheater chamber. The dry pipe and steam pipes are outside the boiler and communicate respectively with the saturated and superheated steam chambers in the header, by way of the openings in the saddle casting. The superheater is fitted with the usual arrangement of shut-off damper.

The fireboxes of all the locomotives are alike. The inside and outside shells are each composed of eleven channel sections. On the coal-burning locomotives the grates are mechanically shaken by a pair of steam cylinders placed under the boiler barrel, immediately in front of the firebox. Hand-shaking gear is also provided. On seven of the locomotives the grate bars have fine fingers and narrow openings and are arranged for burning Gallup coal, which resembles lignite. The fireboxes of the coal burners are provided with two 3-in. arch tubes. The oil-burning locomotives are fitted with the oil-burning equipment standard on the Santa Fe, and including the Booth burner.

The tender is designed in accordance with the Santa Fe standard practice. It has arch bar trucks with cast steel bolsters and steel tired wheels, and the frame is composed of 12-in. channels weighing 40 lbs. per foot. The end sills are of cast steel and are standard for all tenders on the system. The rear end sill is provided with a drawbar carrier of cast steel, which is cast with lugs which interlock with similar lugs on the end sill. When the carrier is in place bolts are applied from the top, extending through the bottom wall of the sill and through the carrier. These bolts are for the purpose of preventing the carrier from sliding off the interlocking lugs and are subject to no stress from carrying the drawbar, as the interlocking lugs receive all the weight. Therefore, even though the nuts should become detached from these bolts they will still remain in place and perform their work properly and no inconvenience can be experienced. This carrier also has pockets on either side of the drawbar for the purpose of carrying the centering springs.



Front End Arrangement of Locomotives Fitted with Schmidt Superheaters.

The following table gives the general dimensions of the coal-

burning locomotives equipped with Buck-Jacobs' and Schmidt superheaters respectively.

General Data.

Gage	4 ft. 8½ in.
Service	Passenger
Fuel	Soft coal
Tractive effort	35,000 lbs.
Weight in working order	276,500 lbs.
Weight on drivers	160,900 lbs.
Weight on leading truck	54,980 lbs.
Weight on trailing truck	60,620 lbs.
Weight of engine and tender in working order	448,000 lbs.
Wheel base, driving	13 ft. 8 in.
Wheel base, total	35 ft. 1 in.
Wheel base, engine and tender	66 ft. 9⅜ in.

Ratios.

Weight on drivers ÷ tractive effort	4.60
Total weight ÷ tractive effort	7.90
Tractive effort × diam. drivers ÷ heating surface*	620.00
Total heating surface* ÷ grate area	71.90
Firebox heating surface ÷ total heating surface*, per cent	5.72
Weight on drivers ÷ total heating surface*	38.90
Total weight ÷ total heating surface*	66.80
Volume both cylinders, cu. ft.	12.10
Total heating surface* ÷ vol. cylinders	342.00
Grate area ÷ vol. cylinders	4.75

Cylinders.

Kind	Compound
Diameter	17½ & 29 in.
Stroke	28 in.

Wheels.

Driving, diameter over tires	73 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	11 x 10 in.
Driving journals, others, diameter and length	9 x 12 in.
Engine truck wheels, diameter	34¼ in.
Engine truck, journals	6 x 10 in.
Trailing truck wheels, diameter	50 in.
Trailing truck, journals	8 x 14 in.

Boiler.

Style	Wagon top
Superheater, type	Buck-Jacobs
Working pressure	210 lbs.
Outside diameter of first ring	70 in.
Firebox, length and width	109¾ in.
Firebox plates, thickness	75/32 in.
Firebox, water space	F. & B., 5 in.; S., 5½ in.
Tubes, number and outside diameter	290-2¼ in.
Tubes, length	18 ft. 2 in.
Heating surface, tubes	3,088 sq. ft.
Heating surface, firebox	237 sq. ft.
Heating surface, total	3,325 sq. ft.
Superheater heating surface	806 sq. ft.
Grate area	57.6 sq. ft.

Tender.

Wheels, diameter	34¼ in.
Journals, diameter and length	5½ x 10 in.
Water capacity	9,000 gals.
Coal capacity	12 tons

Engines equipped with the Schmidt Superheater differ in the following dimensions:

Weight, total	278,840 lbs.
Weight on drivers	162,760 lbs.
Weight on front truck	54,260 lbs.
Weight on trailing truck	61,820 lbs.
Diameter of tubes and flues	2¼ & 5½ in.
Number of tubes and flues	179 & 26
Length of tubes	21 ft.
Heating surface, tubes and flues	2,986 sq. ft.
Heating surface, firebox	237 sq. ft.
Heating surface, total	3,220 sq. ft.
Heating surface, superheater	742 sq. ft.

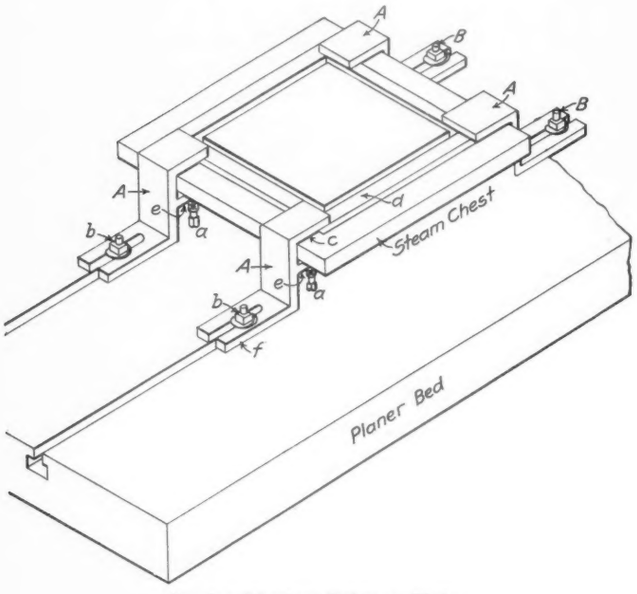
*Includes surface of Buck-Jacobs superheater.

MACHINE SHOP KINKS

BY V. T. KROPIDLOWSKI,
Chicago & North Western, Winona, Minn.

PLANING STEAM CHEST BALANCE PLATES.

A convenient and time-saving method of planing balance plates is shown in the accompanying isometric drawing. The plate is held by four angles *A* which are clamped to the bed of the planer. These angles are made of forged steel 1 in. thick by 4 in. wide when finished. The face *c* of the top jaw and the bottom faces *f* of the foot are carefully planed parallel. The

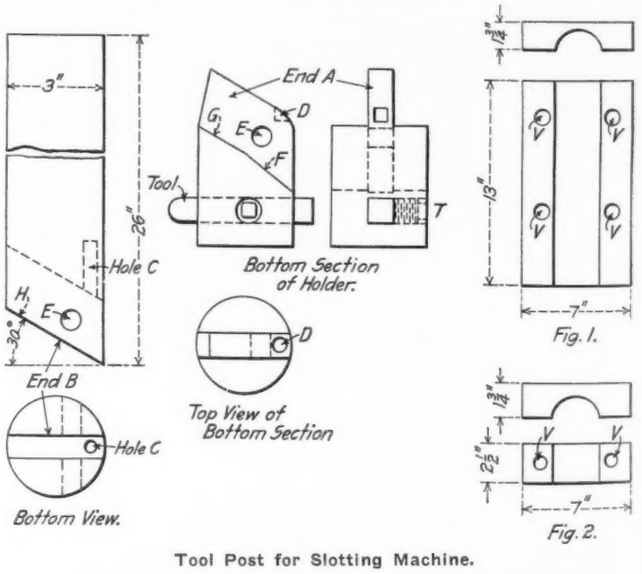


Jig for Planing Balance Plates.

set screws *a* are screwed into the lower part *c* of the jaws, and force the plate up against the surface *c*, holding it while the plate is being planed. No surface gage is required to adjust the cover when using these clamps, thus saving much time and tedious work. The surface *c* of the jaws comes on the finished surface *d* of the steam chest cover, which gives an accurate bearing.

TOOL POST FOR SLOTTING MACHINE.

A tool post of 3 in. round mild steel for use on a slotting machine is shown in the accompanying illustration. The bottom of the post has a slot which receives the end *A* of the tool holder. These two parts are held together by a pin extending through the hole *E*, which also acts as a pivot. The object of the tool post is to allow the tool plenty of clearance while being drawn up, or returned, for the next working stroke. It will be noticed on the bottom section that the surface *FG* is not in a straight line. This allows the tool to swing away from the work on the return stroke. On the down stroke the tool bearing against the work, will hold the surface *G* in contact with the surface *H* of the tool post. In order to insure the tool striking the work squarely when on its down stroke, a spring is located in the hole *C* which



Tool Post for Slotting Machine.

bears on the seat *D* in the bottom section, causing the surfaces *G* and *H* to be in contact when the tool is free. The tool is held in the bottom section by the set screw *T*, as shown. The tool post is placed in the tool head and is held by the two clamps shown in Fig. 2, which are bolted to Fig. 1. This tool is very convenient and saves considerable time, for it can be turned to any angle on account of its being round.

STRESSES IN STEEL UNDERFRAMES

BY OLAF ANDERSON*

The car designer meets new and difficult problems in the design and construction of steel underframes for freight cars; especially in the distribution of the metal and the arrangement of the different members to the greatest advantage consistent with economical design. The great variation of sections in steel underframes at the present time, they being 8 or 10 times stronger than the wood underframe, and each claiming superiority over the other, is subject to criticism. It is believed that if the different stresses to which a car is subjected while in service could be anywhere near analyzed so as to present a comprehensive solution for all car men not familiar with the calculations of stresses and strains, it would help towards the adoption of a standard section of center sills for all cars subjected to about the same service conditions.

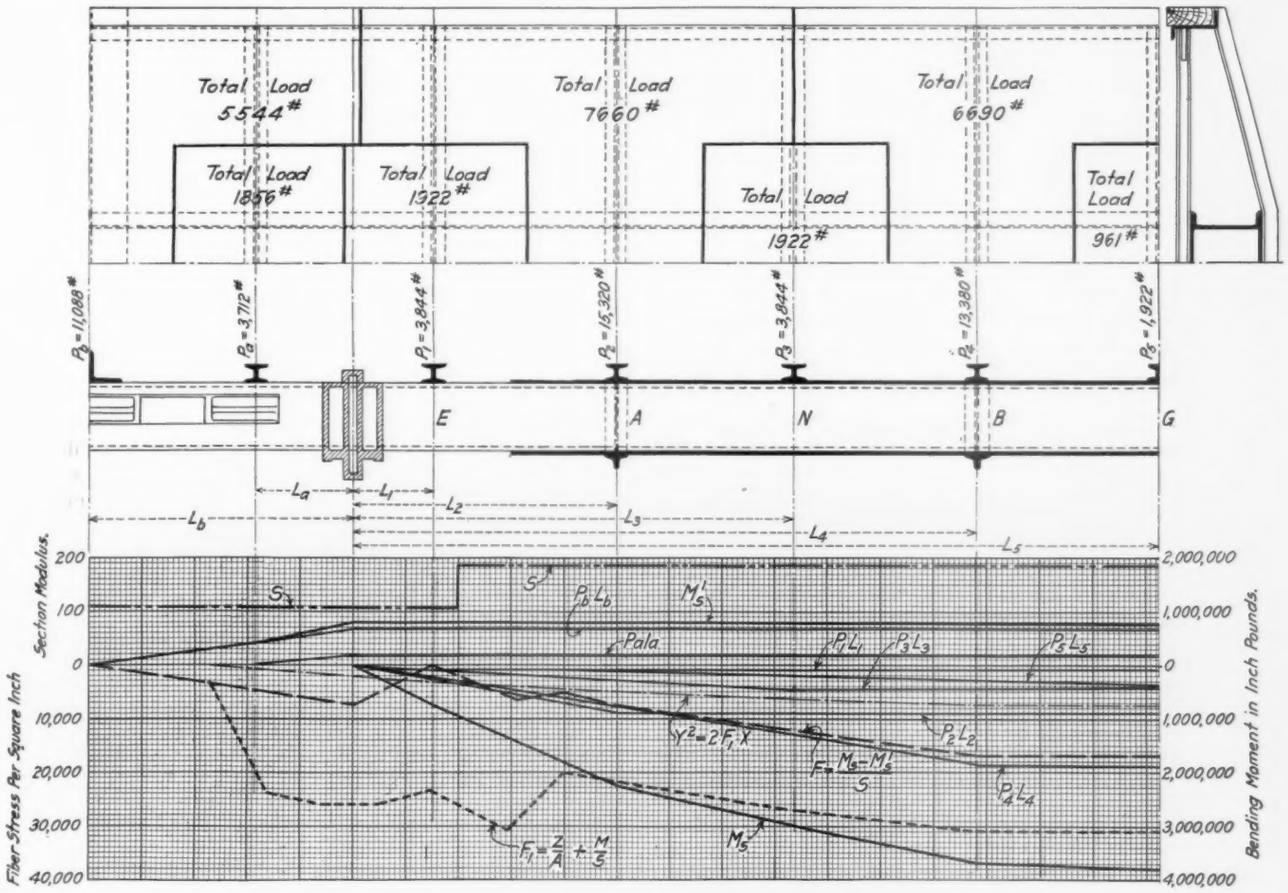


Diagram and Curves for Steel Underframe Calculations.

The following simple method has been used with success to determine and calculate the stresses in a steel underframe box car of 80,000 lbs. capacity, which carried the entire superimposed or live load on the center sills. The underframe had four load transmitters, *A* and *B*, and two others on the other half of the underframe. In addition to this it had five other bearers, *E*, *N*, *G*, and two others, all between the center plates and bolsters, which were of the combination type. There were no side bearings and none of the load was transmitted from the sides of the car to the center plate at the bolsters. One-quarter of the floor plan was used in the calculations, as it was identical with the other three quarters. It was laid out to scale on decimal cross section paper. The live load per square foot of floor area was calculated, the weight of the floor being included as it is uniformly distributed. Boundary lines were then drawn which showed the amount of load in each section acting directly on the center sill.

The cross bearer *N*, for example, carries part of the load between *N* and *A*, and part of the load between *N* and *B*. One-half of the sum of these loads is carried by the center sill, the other half being equally divided between the two side sills. These side sills are supported by the four load transmitters *A*, *B*, etc., and their loads are transmitted to the center sills through them This is clearly shown by the lines on the diagram. To each section included in the boundary lines the dead load or weight of all the members and parts of members, both of the framing and the upper structure, was added. The total load acting at the points *E*, *A*, *N*, etc., may be designated by P_1, P_2, P_3, etc. The overhanging load, or the load transmitted to the center sill, between the ends of the car and the center plate, is designated as P_a and P_b. The distances of the points of application of each of these loads from the bolster is designated by L_1, L_2, L_3, etc.

With this information the bending moments may be calculated and plotted on the cross section plate underneath the drawing Those to the right of the center plate are laid out below the zero line, and those to the left above. These bending moment curves are indicated by P_1, L_1, P_2, L_2, etc. Each individual bending moment should be first plotted separately. As only one-half of the center sill is shown each individual moment curve must take into consideration the effect of the corresponding load on the half not shown. For instance, the moment curve P_1, L_1, represents the combined effect of the load at the distance L_1 from the center plate shown, and the corresponding load at the distance L_1 from the other center plate, not shown. This is done in each case so that the sum of these individual moments at any point will give the resultant bending moment at that point. To form a resultant moment curve the ordinates of all the individual moment curves

*Chicago & North Western, Chicago, Ill.

are added together and plotted, giving the curve M_s and M'_s. The M_s curve represents the sum of the moments below zero line, or to the right of the center plate, while the M'_s curve shows the sum of the moments above the zero line, or to the left of the center plate; to obtain the resultant moment acting at any point of the center sill the two corresponding values must be subtracted one from the other, for the moments on the left hand side of the center plate tend to counteract those on the right hand side.

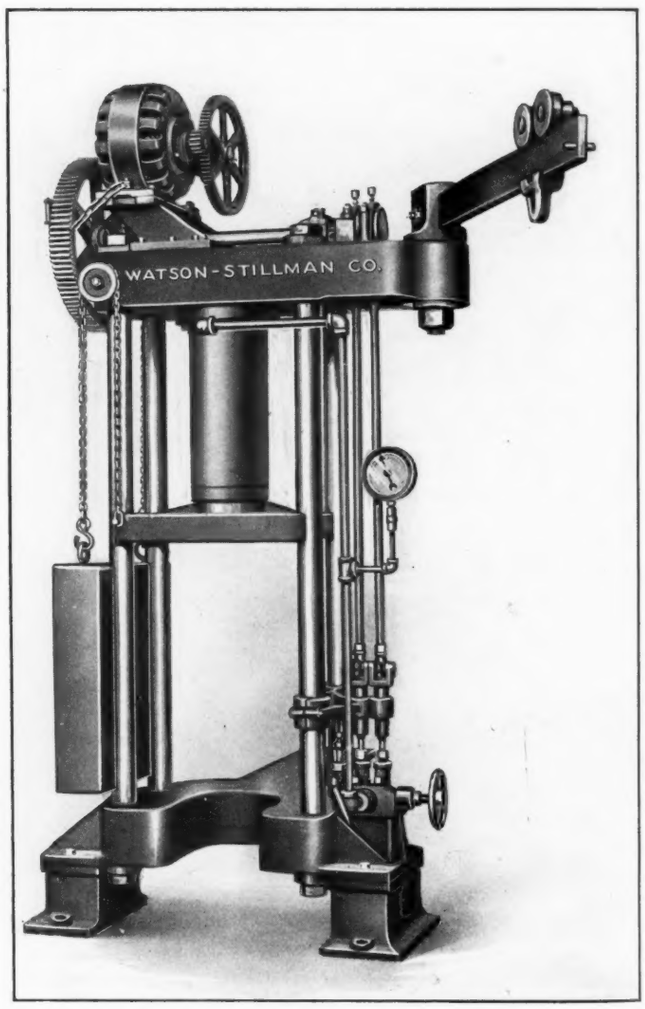
The section modulus of the main carrying members may be calculated and plotted above the neutral line to the scale shown on the left of the diagram. Rules and formulas for calculating the section modulus of different shapes may be found in most structural catalogs or engineering hand-books. The curve of the section modulus being plotted, the unit fiber stress in the main carrying members due to the loading and weight of the car can be determined. Let F equal the fiber stress at any point in the main carrying members due to the loading and the weight of the car, and S the section modulus at the same point. M_s is the corresponding sum of moments below the zero line, and and M'_s the sum of moments above the zero line. Then F equal $\frac{Ms - M's}{S}$ and from the bolster to the end of the car $F = \frac{M's}{S}$.

The different values of the F curve being found, they should be plotted below the zero line, the scale being indicated on the left of the diagram. It is now customary to allow the entire buffing force to be transmitted through the draft gear to the back check castings, as it is usual to allow from ¼ in. to ½ in. between the horn of the coupler and the striking plate when the draft gear is solid. The resistance of all the different members on which the buffing force acts proportionately and simultaneously should not, for economical reasons, be greater than 400,000 lbs., taking as the yielding point the elastic limit of the material. It seems to be the general opinion that the buffing force in switching on gravity yards is frequently as high as 600,000 lbs., or even 800,000 lbs. This is evidently based on dynamometer tests, which, it is believed, would have registered that high if the capacity of the dynamometer car had been sufficient. It is a question whether the dynamometer car records the true force on the drawbar at times when the shocks are great and sudden. It is more likely that the momentum in the oscilliation of the springs and levers causes the pointer to register a higher force than is actually imparted at the drawbar. A special case came to the writer's attention some time ago. A collision occurred between a 500,000-lb. capacity dynamometer car and a steel underframe car equipped with 200,000 lbs. capacity friction draft gears and M. C. B. back check castings. The clearance between the coupler horn and the striking plate was ½ in. when the draft gear was solid. The M. C. B. check castings are riveted to the center sills with 18 ⅞-inch rivets, and assuming the rivets to shear off at 40,000 lbs. per sq. in., if the buffing force was equally distributed on all the rivets, which is very unusual, the rivets would have sheared off at 432,000 lbs. In the collision the springs of the dynamometer car were compressed solid, but no damage whatever was done to the car.

Having assumed the buffing force, we may graphically plot the unit stress in the center sills, due to direct buffing. If F_1 equals the unit stress in the center sills, due to direct buffing, A, the area of the center sills at any point and Z the assumed buffing force, then, F_1 equals $\frac{Z}{A}$ to which should be added the unit stress due to eccentric buffing. Let L' be the distance from neutral axle of center sills to center line of draft. Then L' Z is the bending moment at the middle of the car due to the eccentric force, and the moment curve, which is approximately parabolic, may be plotted from formula $Y^2 = 2\ F_1\ X$, and the value of the curve may be designated as M. Let S_1 equal section modulus in the center sills. Then at any point of the center sills F_1 equals $\frac{Z}{A} + \frac{M}{S_1}$ and the combined unit stress from loading and buffing forces equals $F_1 + F$, and the combined curve may be plotted to scale accordingly.

HYDRAULIC DRIVING BOX PRESS

An electric driven hydraulic press of somewhat novel construction, which was designed by F. F. Gaines, superintendent of motive power of the Central of Georgia, is shown in the accompanying illustration. It has been used for general press work in the shop, being more particularly designed, however, for pressing brasses into and out of driving boxes. It will be seen that the two pumps near the base are driven by long rods connected to eccentrics on the end of the pump shaft, which extends across the top of the press, this shaft being driven by the motor through double reduction gearing. The pump pistons are about ¾ in. in diameter and have a 2 in. stroke. The reservoir is in the pedestal legs and a single valve controls the operation of the press. A



Compact Powerful Hydraulic Press for General Shop Use.

safety valve is applied to prevent dangerous overloading of the pumps.

A crane bracket and beam are provided as part of the equipment on both the 60 and 100-ton capacity sizes. Watson-Stillman Company, New York, are manufacturing the press and will furnish it either electric, hand or belt driven, as desired.

Export Coal Trade.—The great bulk of the export coal trade is to Canada, reports showing that of $15,335,856 worth of anthracite exported, Canada received $15,126,207 worth; of $28,000,000 worth of bituminous coal sent out of the country, Canada received $21,000,000 worth.

IMPROVED SHOP PRACTICE AT NASHVILLE

Awarded the First Prize in a Competition on Shop Improvements During 1911, Which Closed December 15. Includes General Shop Improvements and Descriptions of a Number of Labor Saving Methods and Devices.

BY WILLIAM G. REYER

General Foreman, Nashville, Chattanooga & St. Louis, Nashville, Tenn.

The improvements made during the past year which directly pertained to the increase of the shop output and efficiency, included changes in the layout of the shops, in the schedule of hours, in the instruction of apprentices and the addition of new shop

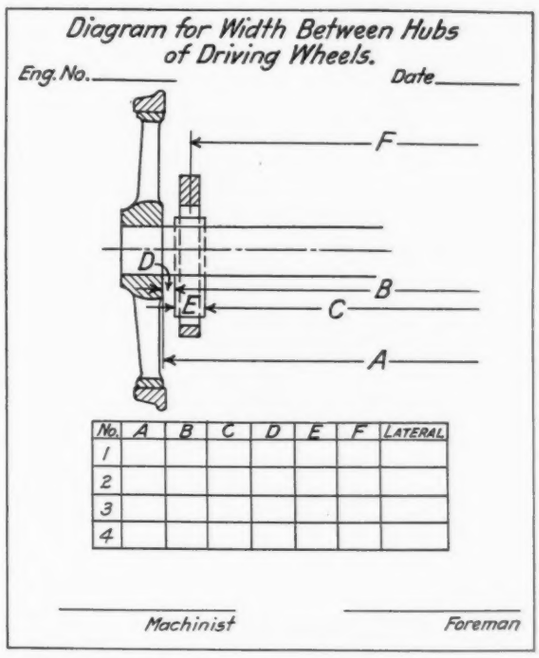


Fig. 1—Dimension Chart for Width Between Hubs of Driving Wheels, Etc.

kinks. In 1910 two of the 15 pits in the erecting shop were closed to provide more floor space for other purposes. This was found to give very good results, and since then a third pit has been closed. There are now twelve working pits, and more work has been done on them than when all of the fifteen were used. This increase is attributed the greater floor space available, which allows the men to have more conveniences and to specialize more highly, as was mentioned in the *Railway Age Gazette* of February 3, 1911, page 243. The more the men specialize in their work the better the results, both in the amount and quality of the work turned out.

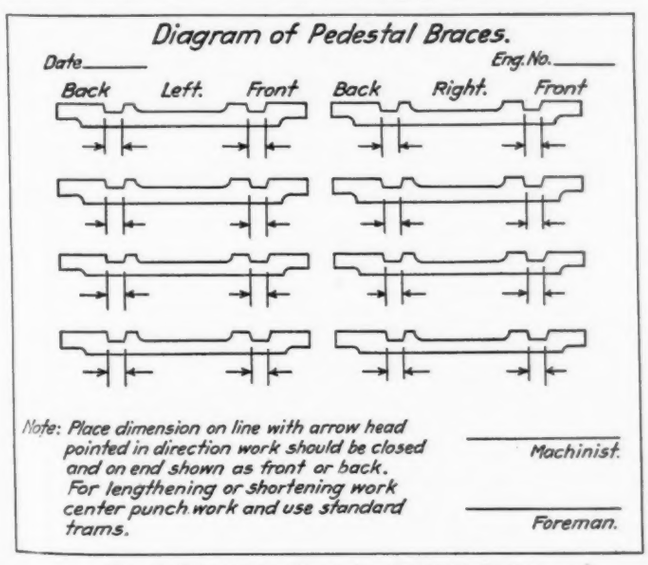


Diagram of Pedestal Braces.
Date
Eng. No.
Back Left. Front
Back Right. Front
Note: Place dimension on line with arrow head pointed in direction work should be closed and on end shown as front or back. For lengthening or shortening work center punch work and use standard trams.
Machinist.
Foreman.

Fig. 2—Dimension Chart for Pedestal Braces.

The apprentices are given instruction on each class of work,

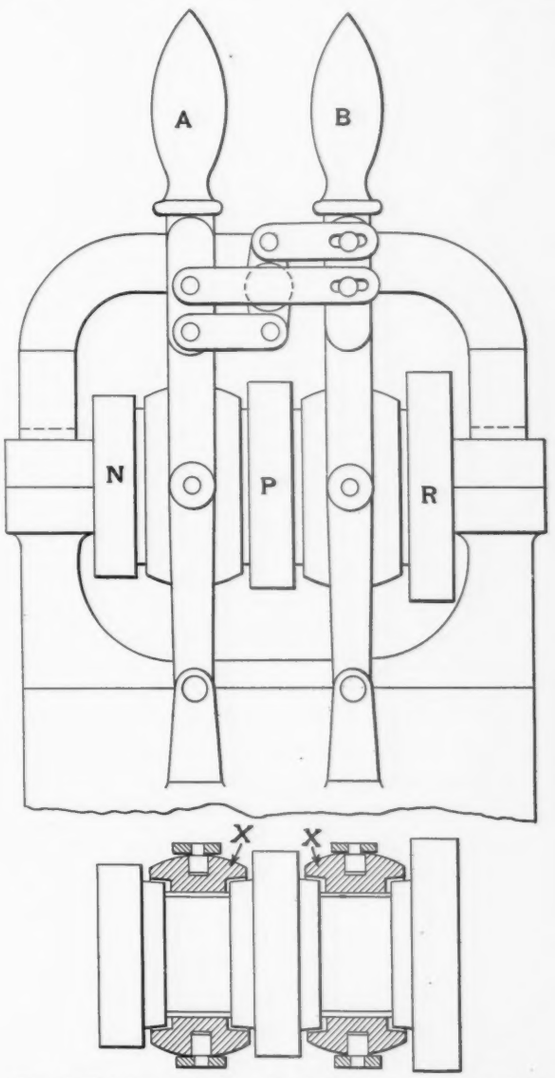


Fig. 3—Friction Clutches for Quartering Machine Feed.

which, together with the apprentice school, makes them all round, thorough machinists. Both the apprentices and the handy men are trained to meet the conditions of our shop. With the proper instruction the amount and class of work a good handy man can turn out is surprising. Another thing that has helped increase our output has been the half holiday given the men on Saturday, the shop closing at 12.30. I believe this is one of the best reforms

inaugurated, both from the standpoint of the men and the railway, for the men get a much needed opportunity to attend to any outside business they may have or to take any recreation they may choose. Following are some shop kinks which were recently inaugurated:

SHOP PRACTICE DATA DIAGRAMS.

The chart shown in Fig. 1 is used for recording the various dimensions between the driving wheels, hubs, etc. The machinist who does the work on the driving boxes gets the width between each pair of driving wheels, placing this dimension on the card at *A*. The machinist who lays off the shoes and wedges fills in the dimension *B*. The lateral play is given by the foreman, and the machinist who works on the boxes calculates the size of the flange he needs on the box and enters it at *D*.

The diagram of the pedestal brace, Fig. 2, is filled out for the blacksmith, giving him the information that he needs to repair the braces. This helps him materially, as he does not have to go to the erecting shop for dimensions.

AUTOMATIC FEED FOR QUARTERING MACHINE.

The arrangement shown in Figs. 3 and 4 was applied to an old quartering machine that had a hand feed. This feed was operated by the wheel *S*, which was keyed to a nut. To apply the automatic feed the nut was extended through the bearing and the gear *W* was threaded and keyed to it. This gear is driven by the small pinion *T*, which is fastened on a sleeve running loose on the shaft *A*. This sleeve is driven by either of the gears *N*, *P* or *R*, which may be connected to it by friction clutches, the gears running loose on this sleeve. These gears are in turn driven by the gears *H*, *K* and *M*, respectively, they being rigidly fixed to the intermediate shaft, which is driven by the gear *G*. This gear meshes with the gear *F*, which is fastened to the sleeve with gear *E*. This sleeve is in turn driven by the gear *D*, which is rigidly connected to the gear *C*, which is driven by gear *B*, which is keyed to shaft *A*. The friction clutches *X*, Fig. 3, are thrown in by levers *A* and *B*, which are connected so that one must be in a neutral position while the other is in use. When the lever *A* throws the clutch into the gear *N* a feed of .017 in. is obtained, and when thrown into *P* the feed is .011 in. Lever *B* thrown into the gear *R* will give a feed of .001 in. This arrangement has greatly increased the output of the quartering machine, and we can feed 6 in. in 10 minutes. It was not necessary to make any changes in the machine to apply this device, the extra gears being held on the bracket as shown in the illustration. The device was designed by H. K. Adams.

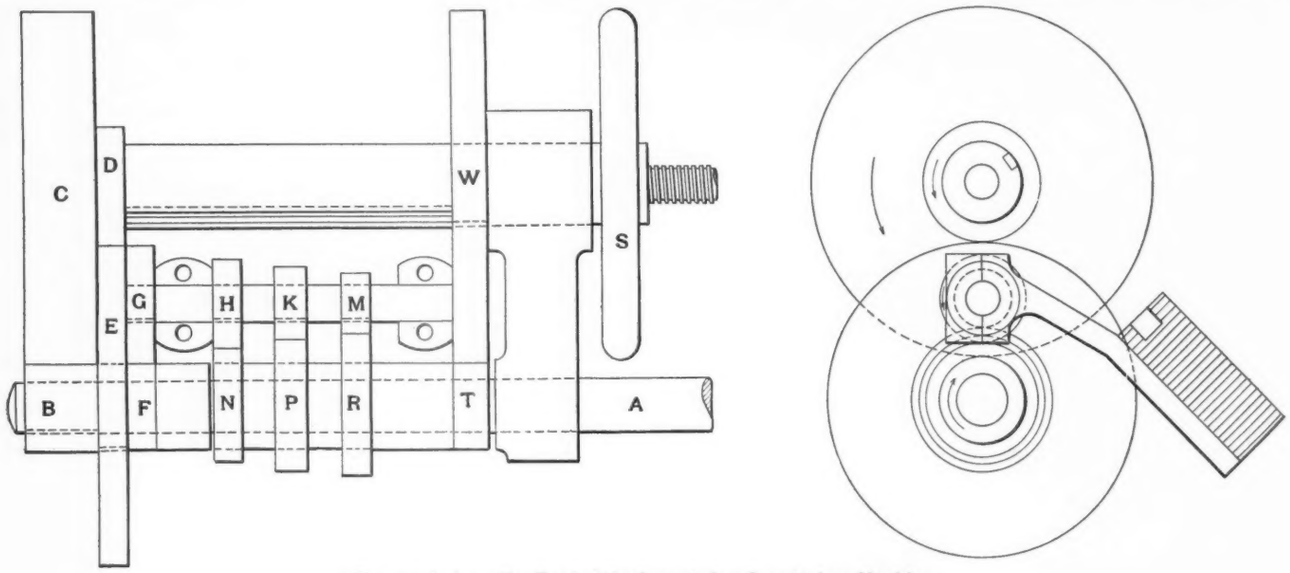


Fig. 4—Automatic Feed Attachment for Quartering Machine.

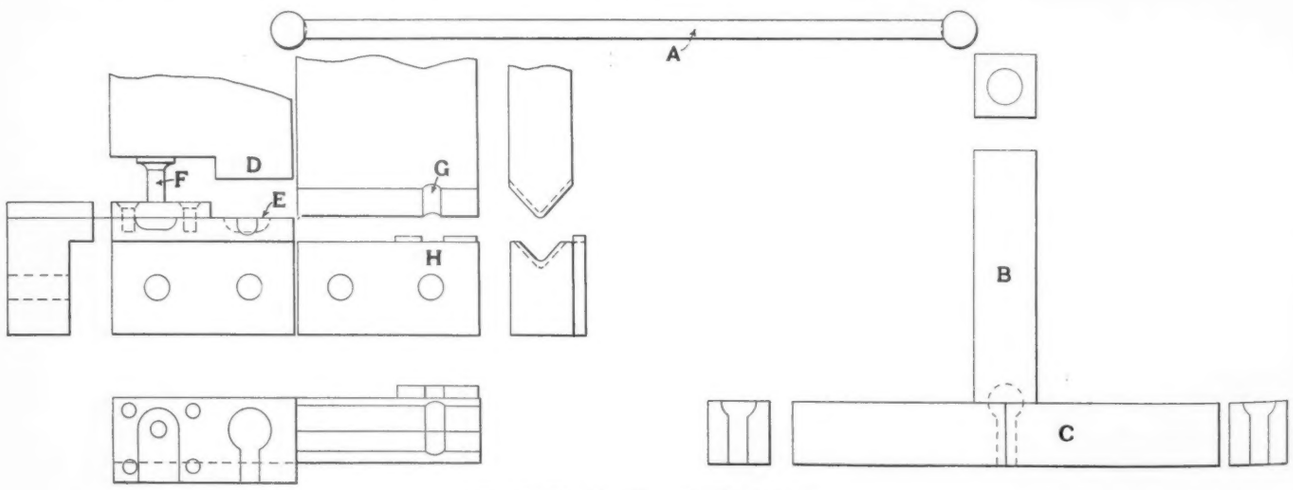


Fig. 5—Dies for Forming Grab Irons.

DIES FOR FORMING GRAB IRONS.

As a result of the recent decision of the Interstate Commerce Commission concerning safety appliances, we have found it

necessary to make grab irons by the thousands. As we have no forging machine, the device shown at the left in Fig. 5 has been applied to our shears. A bolt header, with the two dies *B* and *C*, is used to form a ball on the end of the 5/8-in. rods, as shown at *A*. These are then flattened under the shears in the die *E*, and the flattened portion is then punched out with the punch *F*, forming the hole for fastening the grab irons to the cars. The irons are then placed in the dies *G* and *H* and the ends are bent to an angle of 90 degs. The bolt header will turn out about 1,000 of these irons in 9½ hours, and 600 of them can be punched and bent in the same time. An oil furnace is used to heat the irons. This arrangement was made at the suggestion of Robert Clark, the foreman boilermaker, and John Hooten, the foreman of repairs, made the dies. Twenty-four different lengths and shapes are made with this apparatus.

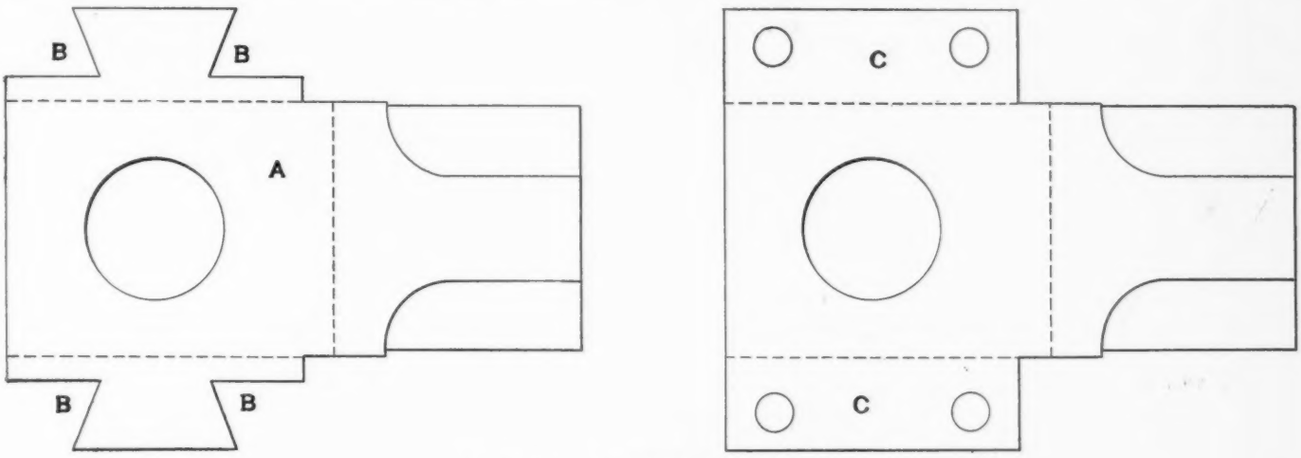


Fig. 6—Method of Reclaiming Crossheads.

REPAIRING CROSSHEADS.

A number of our engines are equipped with the type of crosshead shown in Fig. 6, and each time new gibs are applied the holes in part *C* have to be reamed out. These holes soon become quite large, greatly weakening the crosshead. The following method is used to reclaim them. The crosshead is slotted off at *B* and new pieces of the same material are machined to fit, and are welded in by the oxy-acetylene process.

TOOL BAR FOR SLOTTER.

A new type of tool bar, which is used on driving boxes, is shown in Fig. 7. It consists of the bar *A*, with the bottom portion *B*, which fits in it as shown in the drawing, being connected by the pin *D*. The part *B* is free to swing about this pin, and is held in the correct position by the spring *F*, which bears against the projection *G*. When the tool is on the return stroke this

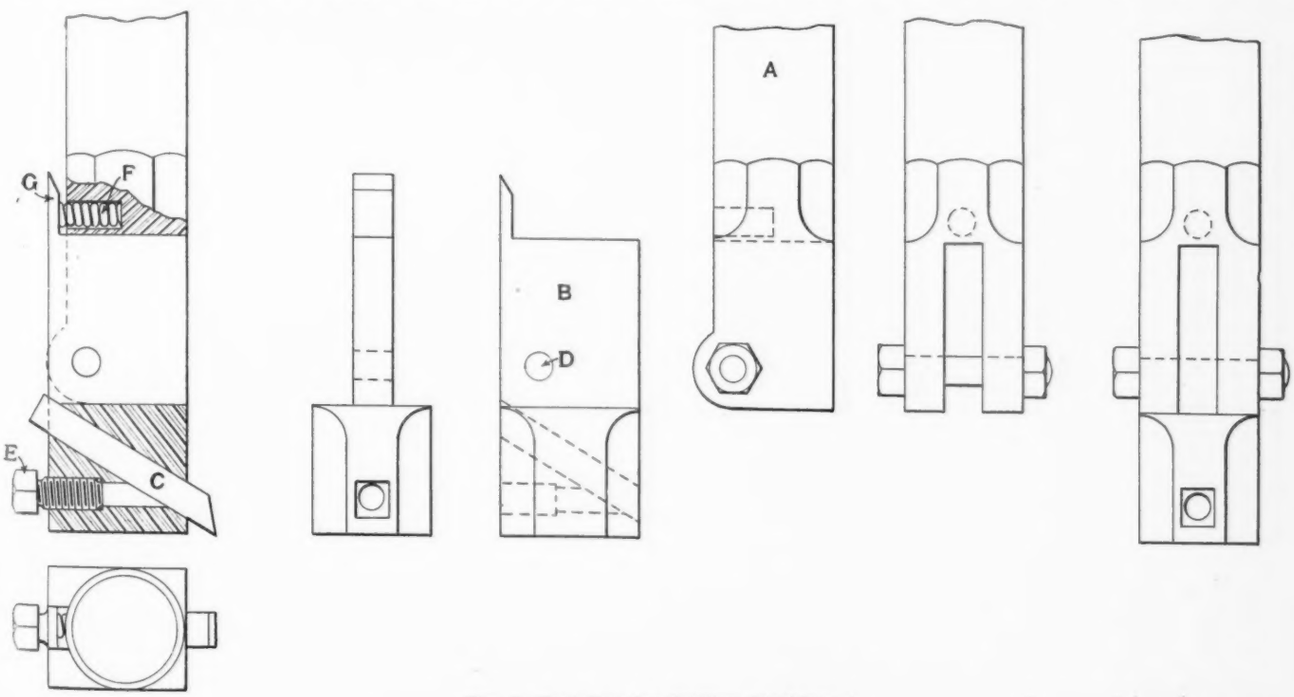


Fig. 7—Tool Bar for Slotting Machine.

spring is compressed, allowing the tool to drag across the surface of the work without injuring it. The position of the tool *C* is of special interest, as it has proved to be a free cutter and will turn out considerable work. The point of the tool is on a level with the bottom of the tool bar, which allows a cut to be taken very near to the top of the table of the slotter. Two driving boxes have been turned out in an hour and a half by this arrangement. The tool was designed and made by Robert Nicks.

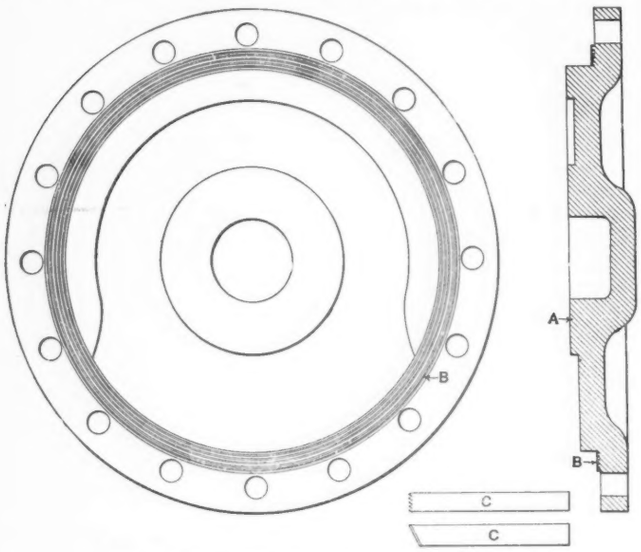


Fig. 8—Method of Grooving Cylinder Heads.

GROOVING CYLINDER HEADS.

The way in which we groove our cylinder heads to save grinding is shown in Fig. 8. The tool *C* is used to make the grooves. Heads treated in this way are being applied to the locomotives as fast as they go through the shop, and save much time, making sufficiently tight joints. It is believed that this surface answers the purpose fully as well as a ground surface.

BULL RING CHUCK.

A new chuck for turning bull rings is shown in Fig. 9. The taper shank *A* is fitted to the spindle of a lathe, the bull rings fitting in the clamps *C*, which are located at the ends of the three arms, extending out from the center of the chuck, as shown. The heads of the bolts operating the clamps fit in the slots in the face plate of the lathe. The radial adjustment is made by the bevel gear *D*, which meshes with the three gears *E*. These gears operate the screws *F*, which drive the sleeves *H* in and out, as desired. The sleeves are kept from turning by the nuts *G*, which slide in slots in the sleeves. This chuck was designed by Fred Eggensberger.

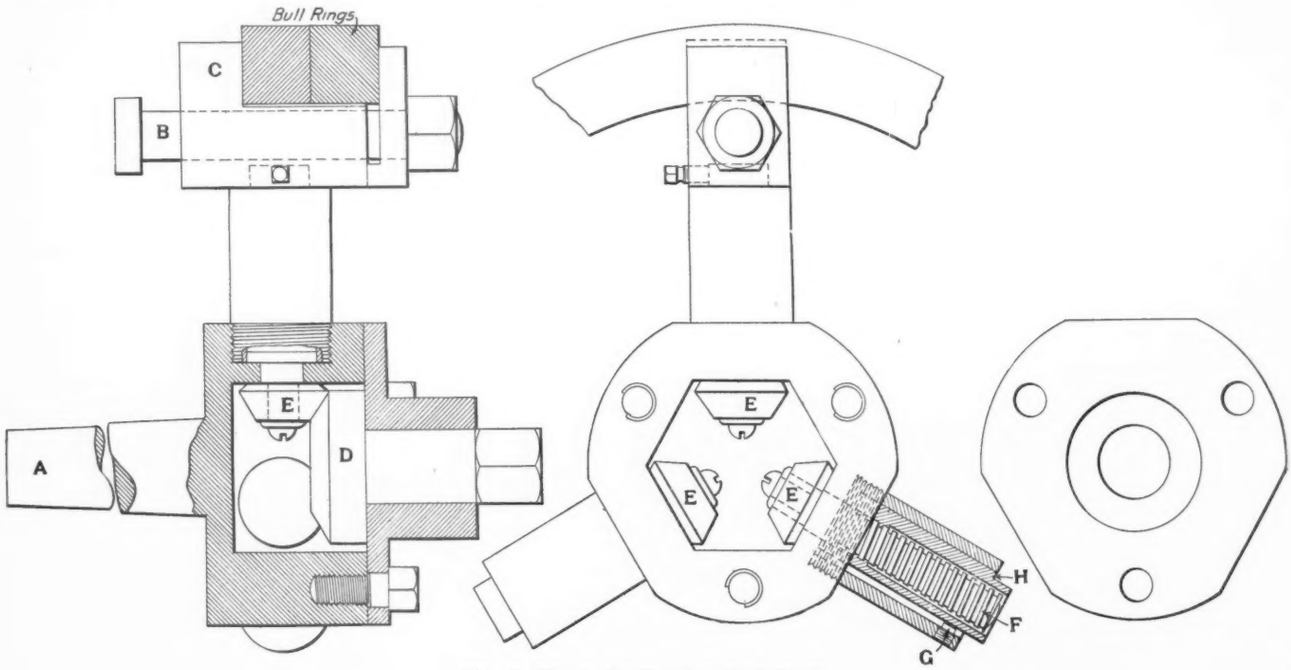


Fig. 9—Chuck for Turning Bull Rings.

DRIVING BOX CHUCK.

A handy chuck for boring driving boxes is shown in Fig. 10. It is also used for facing the ends of the driving brasses before they are applied to the box. The jaws *A* fit over the lip of the driving box and are operated by the right and left hand screw

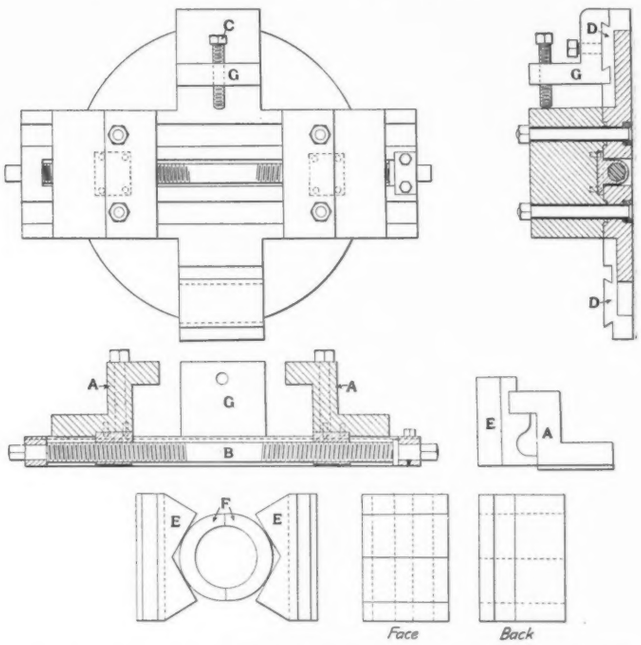


Fig. 10—Chuck for Boring Driving Boxes and Facing the Ends of Brasses.

B. The set screws *C* in the arms *G* give additional support to the box. This chuck does away with bolts and clamps and the operator can easily adjust the box for boring. To face off the driving brasses a pair of supplementary jaws *E* are used, which hold the brasses *F*, as shown. These jaws are held in the jaws *A*

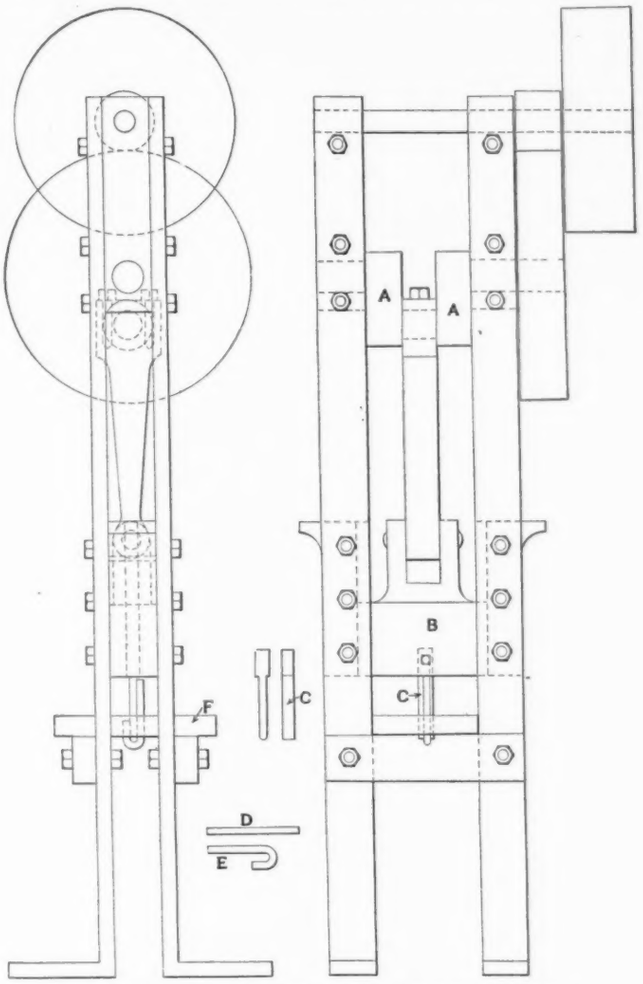


Fig. 11—Forging Machine for Forming J-Hooks.

of the chuck, as shown in the illustration. This tool was designed by Fred Eggensberger.

FORGING MACHINE FOR J-HOOKS.

The machine shown in Fig. 11 is used for forming J-hooks and other light work. It is driven by a belt, which runs on the

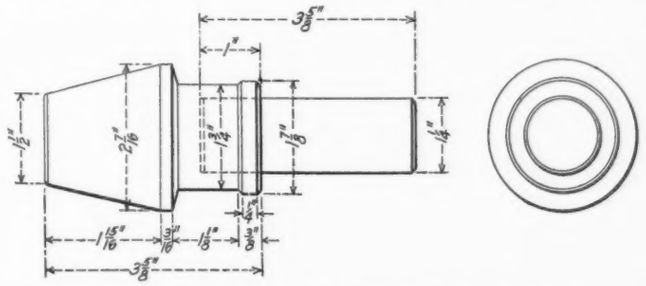


Fig. 12—Pneumatic Tool for Flaring Boiler Tubes.

pulley at the top of the machine, and the ram or crosshead is given its motion through the gears and the cranks *A*. The plunger *C* is fastened in the crosshead *B*, as shown. The round iron *D* is placed on the table *F*, and as it is pressed through the hole in the table it takes the shape shown at *E*. A small oil furnace is located near by to heat the work; about 250 J-hooks can be bent in one hour. This machine was designed by C. B. Landrum, foreman of the blacksmith shop.

PNEUMATIC TOOL FOR FLARING BOILER TUBES.

The tool shown in Fig. 12 is used in a long stroke hammer for flaring over the ends of flues in the firebox. It saves considerable time and makes a first-class job, only a few strokes being necessary to do the work. Three hundred flues can be prepared with it for the beading tool, in one hour and ten minutes. A great deal of trouble was caused at first by the shank of the tool breaking, but this was corrected by making the tool in two pieces, as shown in the illustration.

SOLID PISTON HEADS.

As our engines go through the shop we are doing away with the built up piston heads and are replacing them with those of the solid type, shown in Fig. 13. In this way we are doing away with the bull rings, follower and piston head, making a much

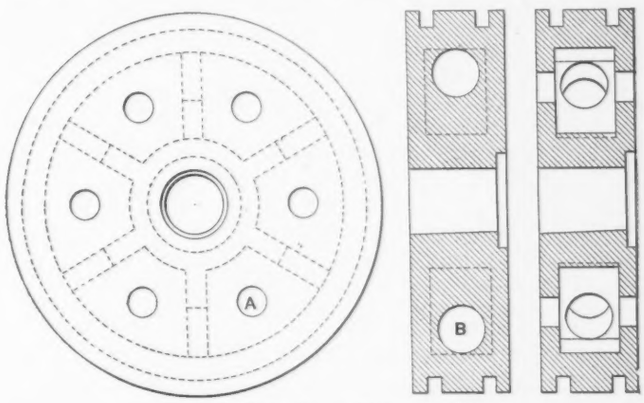


Fig. 13—Solid Type Piston Head.

more satisfactory arrangement. The solid heads are cast with six holes, as *A*, and have a hole through each web, as shown at *B*. The holes *A* are tapped out after the casting has been cleaned and studs are screwed in, being riveted over at each end. This makes a very strong head and is finished on the boring mill in two and a half hours.

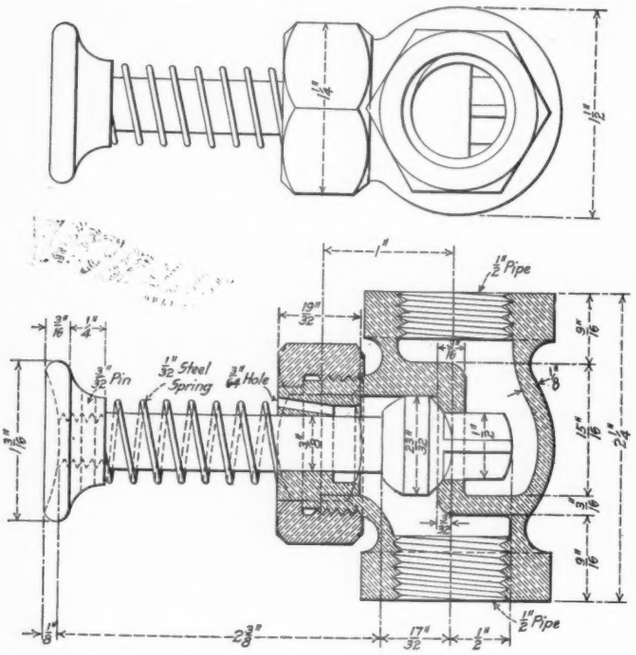
LOW WATER ALARM.

Statistics on boiler explosions, both stationary and locomotive, show that in a large proportion of cases the original cause was low water. This, of course, is generally due to the inattention of the engine crew, but sometimes results from the stopping up of the passages to the water level indicator. For use in either case, an alarm apparatus which automatically blows a whistle when the water level reaches a certain pre-determined point, has been applied to a number of locomotives on the Southern Pacific. It has been in service with excellent results for over a year, and is now being applied to all new power on this road and to some locomotives on other roads. The apparatus was designed at the Los Angeles shops of the Southern Pacific, and has been found suitable for use on stationary boilers as well as locomotives.

As shown in the illustrations, it consists of a cast iron cylindrical chamber with adjacent passages for the circulation of water and steam, which encloses a steel cylinder *B*, containing about 3 lbs. of mercury. There is a ¼ in. space at the sides and bottom between the mercury cylinder and its enclosing casting. A ⅝-in. passage at the bottom leads through *A* to the connection on the boiler, which is located at a point below which it is believed the water should not be allowed to drop. The method of determining this point is shown in the general drawing and depends on the grade on which the locomotive is to be operated. It may be seen that the alarm is thus given before the crown sheet is bared, differing in this respect from fusible plugs. Above the

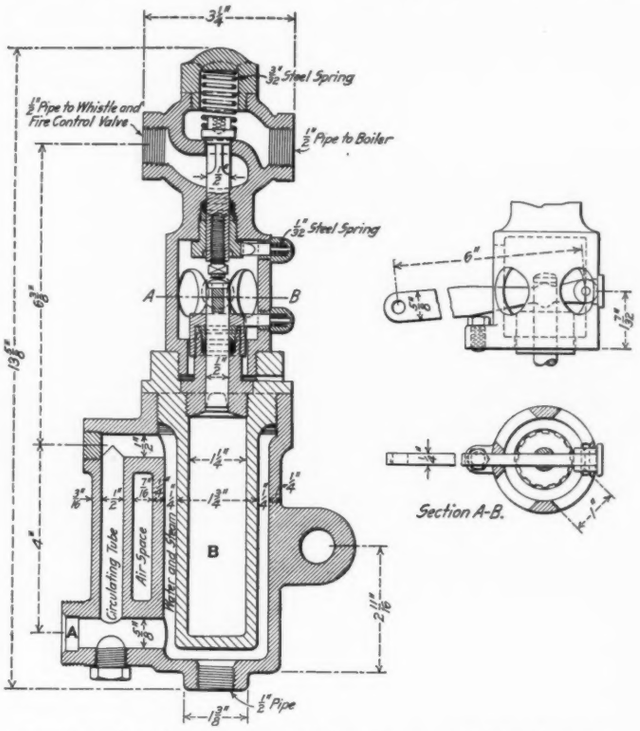
mercury is a half-inch piston suitably fitted with packing, which passes through an adjustable connection to the stem on a half-inch steam valve. This valve is held on its seat by a steel spring of sufficient size to force the piston and connecting parts down as the mercury recedes.

The space around the mercury cylinder contains water which is



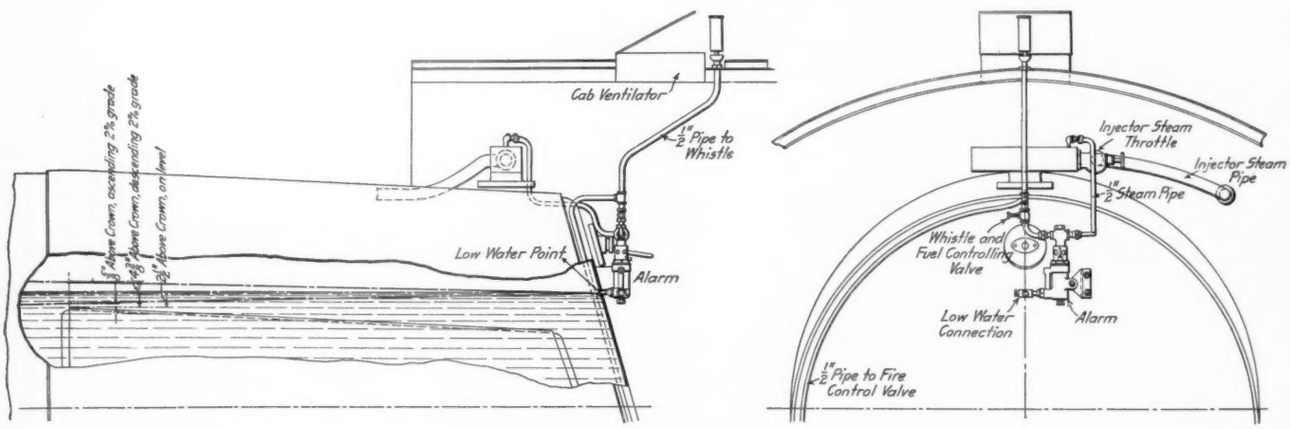
Semi-Automatic Valve in Pipe Leading to Whistle and Fire Control.

entrapped from the boiler, and since there is no opportunity for circulation, it becomes cool by radiation and is held in place by the pressure in the boiler up to the time the level drops below the opening to the apparatus. When this occurs the water is replaced by steam, which can circulate through the passages provided for the purpose, and the increase in temperature expands the mercury, forcing up the piston and raising the steam valve, thus allowing the steam to pass to a whistle and to a valve on the oil supply line in case of oil-burning locomotives, or for opening blow-off valve for spraying the fire in case of a coal-burning engine. The whistle will continue to blow and the spray continue over the fire as long as there is any steam in the boiler, unless the semi-automatic valve, which is shown in detail in one of the illustrations is closed. When this is done the flow of steam is shut off and the water level can be brought up to the proper point and the operation of the locomotive be continued without loss of time. This semi-automatic valve remains closed until the control valve of the alarm is seated by its spring, which will not occur until the space around the mercury is filled with water



Section of Automatic Low Water Alarm and Fire Control Apparatus.

and cooled down. When the steam pressure on the semi-automatic valve is then released through the leakage port, the spring raises the valve from its seat and puts the whole apparatus into its original condition ready for service.



Application of Low Water Alarm.

Locomotive Fuel Oil in Russia.—Nearly one-fourth by weight of the locomotive fuel used in Russia in 1908 was petroleum or petroleum residuum. A ton of petroleum costs as much as 2.55 tons of coal, and in Asia it serves for a little less than twice as many miles, but in Europe for only 64 per cent. more, perhaps owing to a greater use of residuum in Europe. Sixty-nine units of petroleum are said to be equivalent to 110 of English coal, and to 273 of a coal produced in Eastern Siberia. The cost of locomotive fuel in 1908 was 14.78 per cent. of the total working expenses of the Russian railways.

LEGISLATION ON MECHANICAL MATTERS

Explanation of the Conference Committee Methods Lately Utilized for Handling This Class of Legislation*

BY C. A. SELEY

Mechanical Engineer, Rock Island Lines.

The regulation of the railways by means of administrative bodies divides itself naturally into two general classes. The one has to do with that feature of the regulation in which is involved a conformity with the law as interpreted by the courts, and the other with the administration of the physical and as distinguished from the legal. The first of these has to do mainly with the prevention of discriminations and other abuses, while the second touches the railways in the matters of every-day life, and the influence extends down into every portion of the service. As the speaker is not a lawyer, it is not his purpose to cover more than one phase of the subject wherein the engineer has been useful in shaping the details of legislation.

The laws which regulate the various functions of the railways are administered mainly under the control and direction of the Interstate Commerce Commission. Many of these require elaborate codes of rules and explanations for their proper understanding and administration, and the inquiry naturally arises as to how these rules and instructions which have to do with technical details were originally derived. Surely it would be difficult to find a department of the government dealing with more diverse subjects and on which there must be a multitude of questions arising from the various subjects covered by the regulation which the commission is empowered to direct. One might expect to find a very competent staff of legal, accounting and engineering talent in connection with such a department of the government, and there may be, but the mechanical engineer is not strongly in evidence.

It is self-evident that without the expenditure of great sums of money and a great deal of time the government cannot obtain the services of a body of experts which can compare in ability with those already in the service of the railways; and, second, that even if they could obtain such a body of experts, to bring these men to the point which has been reached by the railways' through so many years, would take another long period. As a result, it becomes peculiarly an act of good citizenship on the part of the railways to place their expert knowledge at the service of the government.

Some two years ago the idea was advanced that inasmuch as it was clearly evident that public policy required the enacting of laws and regulations further controlling the activities of the railways it might be well if the men engaged in the practical operation of the roads would interest themselves in the form which the statutes proposed to be enacted should take, not with a view to necessarily making them less comprehensive, but with the idea that the intrusion of practical thought in their formation might result in their being workable to a certain degree. At that time this was considered a very radical view; nor was it completely formulated in the first instance. This policy developed a further field of co-operation, in the fact that under most of the legislation covering physical regulation there was involved the formulation of rules and standards for the government of the carriers, and in these formulations the experience of practical men would be just as valuable, and in fact more so, than in the consideration of the primary law itself upon which the regulations were based.

Acting on this theory, during the Sixty-first Congress it was the policy of the roads whenever any bill was under consideration relating to railway operation to present before congressional committees, men who from their knowledge and experience could tell such committees exactly what the proposed legislation meant and what the effects thereof would be. There is no question as to the necessity for this procedure. As an illustration, it is a matter of record that it was necessary for one of these witnesses to explain to a committee that the water in a locomotive boiler was not contained in the tubes; and to this co-operation between congressional committees and witnesses for the railways may be attributed the fact that such legislation affecting the physical operation of railways, as passed the Sixty-first Congress, was intelligent and of a character that it was possible to enforce without testing the matter in the courts. Under some of these statutes it was necessary to formulate certain standards and rules, notably the standards of United States safety appliances, and the rules for locomotive boiler inspection. The first of these was under consideration before any of the others. There was serious danger that the United States safety appliance standards would be formulated without due consideration as to practicability and difficulty of enforcement, and for some time there was very serious question as to whether any co-operation or assistance from the railways would be accepted on the part of those responsible for the formulation of such standards. However, after this principle was established the proceedings were rapidly conducted, and the benefits of such an arrangement were so manifest that in every case which has occurred since that time not only has this co-operation been welcomed, but in many cases has been sought by the representatives of the departments of the government charged with the enforcement of the laws.

United States safety appliances have been referred to; these are the ladders, handholds, sill steps, running boards, etc., on railway cars and locomotives. The Master Car Builders' Association, a representative body, had for years illustrated and described consistent arrangements of these appliances in its proceedings as standards, and, if all railways had fully complied with the requirements of these standards on their rolling stock it is not likely that the recent legislation on that subject would have been enacted. It is a fact that the standards of the M. C. B Association are not obligatory on the railways, but its practice in respect to the safety appliances was satisfactory to the Interstate Commerce Commission for many years as complying with the law. The labor organizations engaged in railway transportation developed a feeling that this was not sufficient and succeeded in persuading congress to pass an act directing the Interstate Commerce Commission to prescribe the number, dimensions, location and manner of application of these various appliances, so that they would be uniform as nearly as possible on all cars.

The standards were to apply on all cars built after July 1, 1911, and the commission was authorized to name the time limits in which equipment built before that date should be changed to comply. The latter equipment, including about two and one-half millions of freight cars, was by far the most important feature, as it would be comparatively easy to change drawings and specifications for new equipment not yet built. To go over every old car and make the necessary changes to comply with a set of rather rigid requirements involved enormous expense, both direct and indirect. The secretary of the Interstate Commerce Commission asked for a committee from the railways to assist in compiling the proposed standards for new cars, and when this

*Part of an address delivered before the engineering students of the University of Illinois, January 4, 1912.

work was done the Interstate Commerce Commission had a hearing at which these proposed standards were submitted in the usual form with opportunity for argument.

The railways present by their representatives at once took the ground that the matter was not in shape for a hearing and final determination; that while they could comply with the requirements on new cars, that the rigidity of the standards should be modified, variations allowed, and that liberal time should be granted for changing the older cars. Some little time was taken in discussing the details, but it all proved that the position of the railways was correct and the hearing was adjourned to permit of a conference committee handling of the matter. This committee consisted of fifteen members, five railway mechanical men, five Interstate Commerce Commission inspectors and five labor organization chiefs, representing the locomotive engineers, firemen, conductors, trainmen and switchmen. The conference lasted several days with much argument and mutual concession and settled the matter entirely save two or three points on which no agreement could be reached. These and the agreed points, together with the respective arguments, were submitted to the Interstate Commerce Commission in a second hearing, and an order was issued under which the railways are now working.

The labor organizations were also not satisfied with the inspections of locomotive boilers, as made by the railways; at least they apparently could not understand why the engine crews were generally blamed in case of boiler explosions, and they determined to have a federal boiler inspection law. Several bills were introduced in Congress, but by intelligent presentation of information and records of the roads' methods of inspection and tests at the committee hearings the more radical and unreasonable bills were successfully opposed. It was, however, recognized by the railways that they could not consistently oppose reasonable regulation in the matter, and conferences were held with those interested to determine the essentials of a reasonable boiler inspection law. The Master Mechanics' Association had reported a set of minimum rules applying generally to all locomotives based on general practice. These were considered together with methods of administration, force and the scope of their duties, etc., and the present law was framed to include these considerations and was not opposed by the railways.

The law provided that the Interstate Commerce Commission should formulate and issue the rules under which the railways should inspect, test and report their boilers. The five railway mechanical men who had conducted the safety appliance negotiations met with the boiler inspectors of the commission and the labor organization representatives and agreed to the code of rules which by order of the commission now regulates our boiler inspection.

I will not weary you with the detail of all the routine necessary in those negotiations; of the calling of a general meeting of the railways to settle preliminaries, of the authorizing of the conference committee to represent all the roads, of the reporting to the general meeting for approval of the results reached in conference before they are submitted to the commission, and the final discharge of the conference committee, so far as that subject is concerned after the commission's order has been issued.

Recently the post office department asked for a conference with the roads in regard to formulating specifications for the construction of steel full postal cars and for the uniform arrangement of the equipment of both full postal and apartment cars. The matter was taken up by a general meeting of the roads who again authorized the conference committee of mechanical officers, reinforced by a couple of mail traffic managers, to represent them, which they did, first ascertaining the scope and extent of the general features desired to be covered. The committee, assisted by the engineers of the car building companies, who cheerfully gave of their experience and knowledge, then formulated a specification for steel full postal cars. After the specification was completed and unanimously concurred in by all members of the committee and by the assisting engineers of the car builders, it was referred to and approved by a general meeting of the railways. It was then submitted to the committee of the post office department and thoroughly discussed in an extended conference. It will doubtless take some little time to entirely settle the matter, as the specification is very complete and voluminous. The post office department committee found it rather difficult to understand and assimilate the engineering portions of the specification relating more particularly to the strength of the structure, as section moduli was a term not ordinarily used in post office transactions. They were surprised that we could not give them direct comparisons of the strength of wooden and steel cars and had hoped that we could help them to arrive at a single standard of design. The specification was printed in the December issue of the *American Engineer,* page 490, and in the November 24 issue of the *Railway Age Gazette,* pages 1049 to 1051.

The work of the committee had to include several important considerations. First, the post office department had accepted several designs of steel postal cars, none of which had been demonstrated as a failure. Hence, it was obvious that the specification should be broad enough to include all of the designs.

Second, the specification, in order to be authoritative, should have the approval of all the designers of the various types included, and also of the users of the cars who by experience in handling and maintaining them could judge of their suitability to the service and the general results of the designs in normal operation as well as in repairs and wrecks. We were fortunate in having the unanimous approval of all the engineers and of the railways back of our specification.

Third, due regard must be paid to the evolution of steel car construction in the future, and the form of the specification should not be such as to bar progress in design and improvement in materials.

Fourth, Congress may pass one of the several steel passenger car bills that have been introduced, and doubtless the postal car specification would be studied as to its application to other types of steel passenger equipment cars.

It is admitted that as the postal car is generally placed next to the engine it is in a place of greater hazard than are other cars in the train in the case of a head-end collision, and we agreed to furnish a greater measure of strength in the end framing to minimize the danger of telescoping. Aside from this, however, we do not feel that the structure of a postal car should necessarily be stronger than that of other types of cars and the best results can be obtained by having consistent strength throughout the train.

The public has gained some very erroneous opinion about the strength of steel cars. If they were in fact so strong as to resist deformation in a severe wreck it must be apparent that they would pass the shock along to the contents of the cars, human and otherwise, in dissipating the stored energy. It has been amply demonstrated by experience in several wrecks that the amount of damage and injury is greatly lessened by providing a yielding resistance in the end of the car, such as the folding up of the vestibule or platform or partial failure of the end construction. If these parts are so strong as to resist failure, the shock will be transmitted until it is dissipated at a greater risk to life and the contents of the cars.

The principal advantages of steel passenger car construction are the absence of splintering and less danger of fire from external causes in case of wreck. Danger has been feared when both wooden and steel cars are used together in trains, but a wooden sleeper has been known to telescope a steel sleeper, and a prominent lumber association has spread broadcast photographs showing how well a wooden dining car in an otherwise steel train had withstood injury in a severe wreck. The truth is that wreck conditions are seldom so similar as to permit direct comparison, and, while the wooden cars are the result of an evolution covering several decades, the steel car is of very recent origin, and, that we can reasonably expect improvements in

design, reduction in weight, and cost as has been the case in development generally of equipment, machinery and other structures.

The postal car specification provides that the underframe is to be calculated on an assumed end shock equivalent to 400,000 lbs. static load, which will take care of very heavy switching and service conditions, but not of extreme collision shocks, which should be dissipated by end failure. Thus it will be seen that the duties of the conference committee have been so varied as to require a considerable range of practical information as well as technical and engineering knowledge. The handling of these questions in the conferences required skill in debate and argument suited to the caliber and character of the people with whom issue is raised.

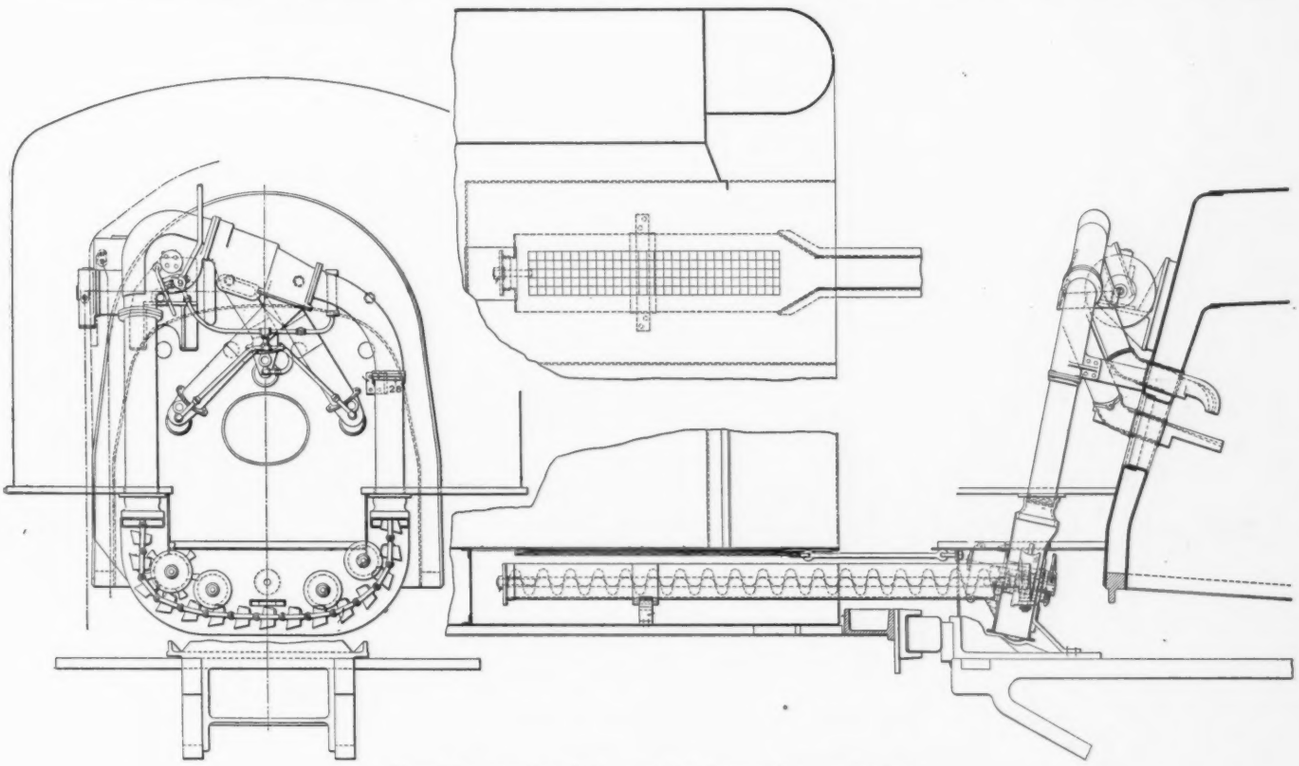
As the conference committee represented all of the railways, the members must of necessity take the broad view and not just that of their own little or big road, as the case might be. The personnel of the committee included the highest officers in the mechanical departments of such railway systems as would practically represent all sections of the country, and while the time necessarily devoted to these protracted conferences was a heavy tax, both on the individual and to his company, yet the results obtained have been so satisfactory as to justify the expenditure of time and the methods employed.

It cannot be too strongly emphasized that the amount of work committed to the various governmental agencies through legislation is vastly in excess of the capacity of the present organization of such agencies to perform satisfactorily. The administration of such vast interests, which should be committed to men of first rate ability in some cases, and in others to men of thorough technical equipment, is left to the tender mercies of men who, however well meaning, have not the equipment necessary for the effective administration of their offices, nor under the conditions with regard to compensation which now exist can these agencies hope to secure men of the type desired. Under these circumstances, the cordial co-operation of the railway administrations is practically essential to prevent utter demoralization in the transportation industry.

That this co-operation has been willingly afforded is clear evidence of the desire of the railway corporation to contribute to the success of the governmental agencies upon their administrative side, and in this respect the railways, which have been a mark for every petty politician for so many years, have demonstrated the appreciation on the part of their officers of their duties as "citizens of no small country."

IMPROVEMENTS IN THE STREET STOKER

When the Street locomotive stoker was first designed it was the desire of its inventor to eliminate as far as possible the physical efforts of the firemen, and the original conception included a method for automatically transferring the coal from the tender to the elevator. The necessity of using the ordinary run of mine coal, however, made it impossible to fully carry out this idea and until such time as crushed coal could be furnished on the locomotive, it was decided to install the crusher which has formed a part of this appliance.* While the labor involved in placing the coal in the crusher is very light, this arrangement does not fulfill the ideas of the inventor and was looked upon as a temporary expedient to be used until the time arrived when there would be sufficient stokers in operation to make the preparation of the coal at the chutes advisable. Locomotive stokers are now becoming more common and Mr. Street has perfected a conveyor for use where suitable coal can be obtained which does away with the separate engine and the crusher on the tender, as well as making it possible to reduce to some extent the size and weight of the stoker proper and also placing the lower hopper of the elevator more convenient for inspection.

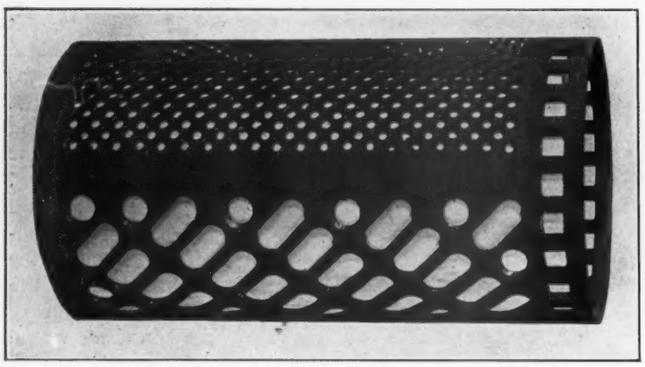


Street Locomotive Stoker of the Screw Conveyor Type.

This new conveyor is of the screw type, the screw being located in a heavy sheet iron trough which extends back from the locomotive underneath the floor of the tender, as

*Illustrated and described in the *American Engineer*, June, 1911, page 232, and in the *Railway Age Gazette*, May 26, 1911.

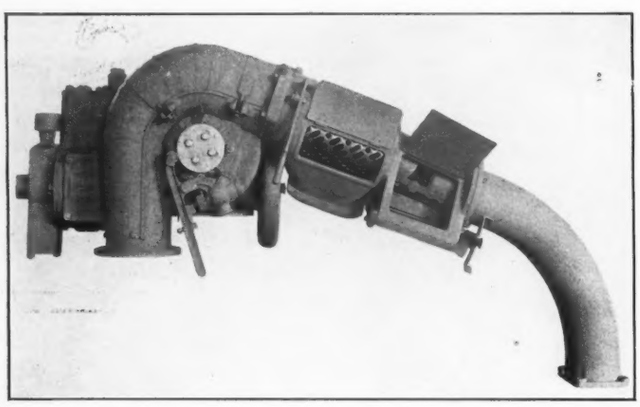
is shown in the illustration. This trough is pivoted on a strong pin attached to the lower hopper of the elevator casing and rests on a wrought iron support bolted to the floor of the tender. A universal joint is provided for driving the screw, making the whole apparatus flexible to accommodate the different relative positions of the locomotive and tender. Over the trough is a screen made of ¼ in. wire, and having a 2 in. square mesh, which is secured in the floor of the tender and is covered by sliding plates 10 in. x 12 in. in size, so arranged that any one of them may be opened as desired



Discharge Pipe Screen; Street Locomotive Stoker.

and required by the position of the coal. The screen is not rigidly fastened to the floor and an agitator is provided which keeps it in motion when the locomotive is running and thus prevents the coal from bridging and clogging up.

The conveyor is driven through a sprocket wheel mounted on an extension of a shaft carrying the guide wheel for the elevator bucket chain. This sprocket drives through a gear box which permits three different speeds of the conveyor. The elevator engine is operated at a constant speed at all times. The handle from the gear box is located at one side of the fireman's seat and enables him to change the speed of the conveyor and therefore the amount of coal fed into



Front View of Elevator Engine, Sprocket Wheel Casing, Discharge Pipe, Return Bend, Controller and Controller Cam.

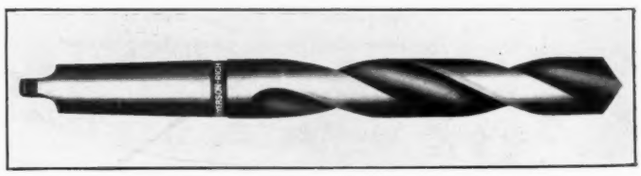
the feed box without leaving his seat. Motion is transmitted from the gear box to the conveyor by a link chain and a pair of sprocket wheels.

Reference to the accompanying illustration and to the previous description of the stoker will show that it has been possible to locate the lower hopper very much higher; in fact, to place it above the frames and just under the cab floor, which reduces the length of the elevator and the weight of the whole apparatus, as well as permitting a ready inspection of the hopper by removing a section of the cab floor while the locomotive is in operation. Movable slides have been provided in the hopper for this purpose and a steam jet is fitted for thawing it out in case of freezing. When taking coal the plates over the conveyor hopper are closed, covering the entire space; when ready to start the stoker the front plate is slid forward uncovering an opening and allowing the coal to slide down into the conveyor until the slope will deliver no more; the second plate is then drawn forward and the others in rotation as the supply of coal is diminished. At no time is there an opening to the conveyor greater than 10 in. x 12 in., which prevents it from becoming overloaded and clogged.

Attention was directed in connection with the Street stoker on the Chesapeake & Ohio Mountain type locomotive (*American Engineer,* October, 1911, page 381), to a new design of distributor consisting of a circular screen in the elevator pipe where the buckets discharge their load. At that time there were no photographs available showing this screen and its operation. It is now illustrated herewith. This screen has four different sizes of openings and may be revolved to bring any one of these sides into operation the coal passing through the screen being carried only to the distributor which feeds the back part of the firebox. Such coal as does not pass through the opening at the bottom of the screen will be distributed to the two side distributors feeding the forward parts of the firebox. The distribution between these two is controlled by a hinged plate capable of adjustment by hand, so arranged that the rolling of the engine or inclination of the track does not affect its operation.

NEW FORGED TWIST DRILL

A high speed forged drill which has shown remarkable results in practical service has been developed after a long period of experiment by Jos. T. Ryerson & Son, Chicago. Starting with the plain flat drill, used principally for rail drilling, this company has gradually developed the forged drill up to the present product, which it is believed fulfills all requirements, both as regards capacity and durability. The drill has the same general shape and cross section as the milled drill now generally in use, but differs from it in that it is forged complete. It is believed that considerable drill breakage is due to the poor quality of material found in the center of bar stock which, after the milling, comprises a considerable portion of the drill. The



Solid Forged Twist Drill.

forging process eliminates all chances of such flaws, besides refining and improving the metal and retaining the continuity of the fibers. So far as appearance and general shape go, it is exactly the same as the most improved form of milled drill. It has a cutting lip of the same form and is constructed with the same clearance.

Records of practical service with these drills show some rather remarkable results. In one case, 6 13/16 in. drills bored 40,000 holes through structural beams from 1 in. to 2⅝ in. in thickness, and were still in good condition. In another case a 2¼-in. drill bored three holes through a 40-point carbon steel block, which was 8¾ in. thick, in 7, 7, and 6½ minutes respectively. A ¼-in. drill made 600 holes through a ¾-in. steel bar without sharpening; the ordinary twist drills would have required sharpening after 50 holes. A number of users report that they have attempted to break the drill in use, but have found that its capacity was beyond that of their drilling machines.

REPAIR SHOP IMPROVEMENTS AT BUFFALO

An Account of the Improvements That Have Been Made in the Arrangement and Equipment of the Pennsylvania Shops at Buffalo, N. Y. Awarded the Second Prize in the Competition on Shop Improvements During 1911.

BY C. C. LEECH.

Ground was broken for a new power house at the Buffalo shops of the Pennsylvania Railroad in November, 1910. This was the beginning of improvements that have continued ever since and are not yet entirely completed. The general grouping of the buildings and tracks prior to the changes is shown in Fig. 1. The arrangement in Fig. 2 shows them as they are now. A conservative estimate of the increase in general efficiency of the plant due to these changes has been placed at 30 per cent. It will be noted in Fig. 2 that the ground formerly occupied by the old machine shop and planing mill is now used for storage tracks, which provide room for 40 engines, as compared to 15 in the old arrangement. Further, in the old plan there were fewer facilities for engines leaving the storage yard or for those coming out of the engine house, it being necessary to take all of them out over track *A* to reach the main track. Another bad feature of the previous arrangement and a cause of much delay was the necessity of crossing the Erie Railroad at this point. Most of this delay is eliminated by having better outgoing track facilities.

When the old sand house was located, as in Fig. 1, it was necessary in order to sand engines coming in on the ash pit, to move them down to switch *B* and then back along the track, an opposing movement, to reach the sand house. This arrangement not only caused great loss of time to the engines, but also blocked the way of engines coming in on ash pit *N*. The new locatoin of the sand house is the logical one and the best practical solution of the problem. It is of modern construction and has a steam-drying system instead of using a coal stove, which was always an element of danger. The sand, after being dried, is forced by compressed air into the bins overhead; from there it runs by gravity to the sand box of the engine. Another improvement was made by raising the coal chutes some 2 ft. higher to

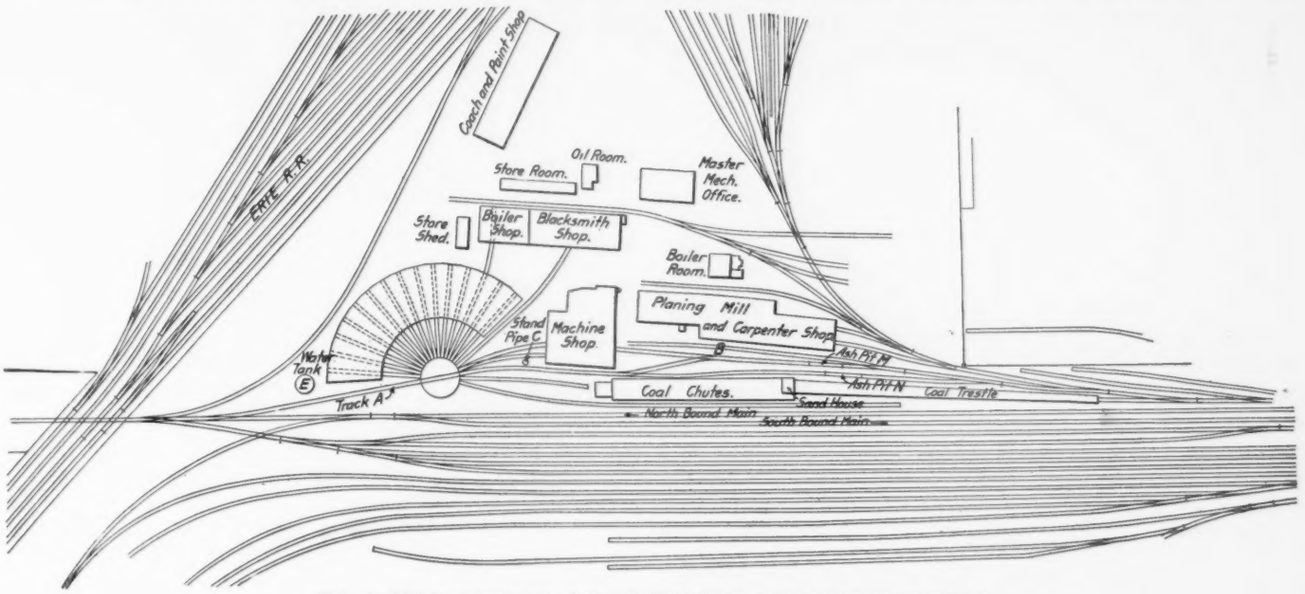


Fig. 1—Old Arrangement of the Buffalo Shops; Pennsylvania Railroad.

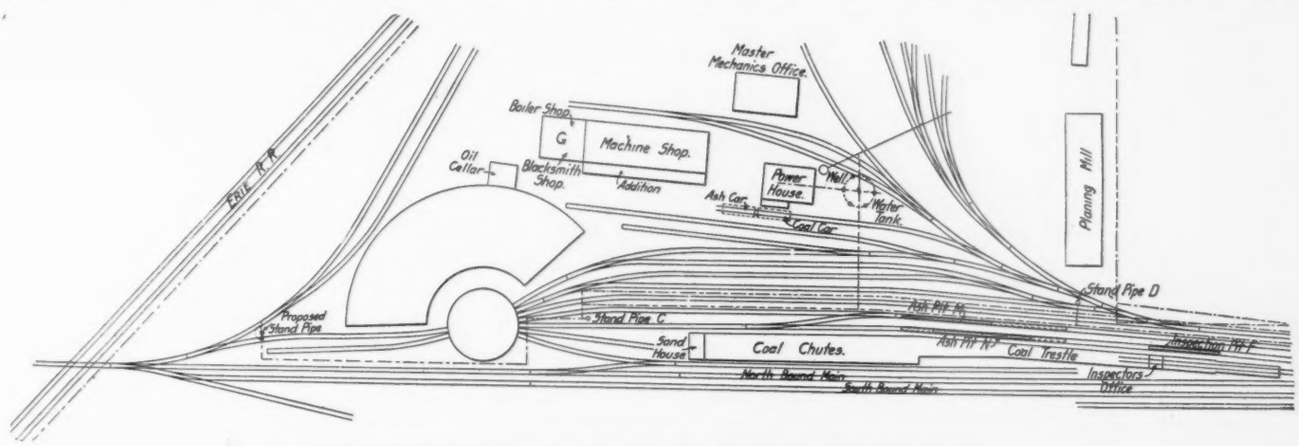


Fig. 2—New Arrangement of the Pennsylvania Shops at Buffalo, N. Y.

accommodate the larger and higher types of locomotive tenders. Coaling is now done in half the time that was formerly required, the increase in the height of the chutes giving a more rapid movement to the coal.

A stand pipe is shown on both plans at *C;* an additional one has been located on the outgoing track at *D,* Fig. 2. This is a particularly important improvement both for outgonig engines and also for yard switching engines working in the immediate vicinity. Much time is saved by not having to go back to column *C* or to the water tank *E.* A new concrete inspection pit was put in at *F,* and a pneumatic message tube has been installed between the engine inspector's office and the office of the engine house foreman. Inspection reports are now sent to the foreman's office in a few seconds, thus saving the time it took the inspector to deliver them.

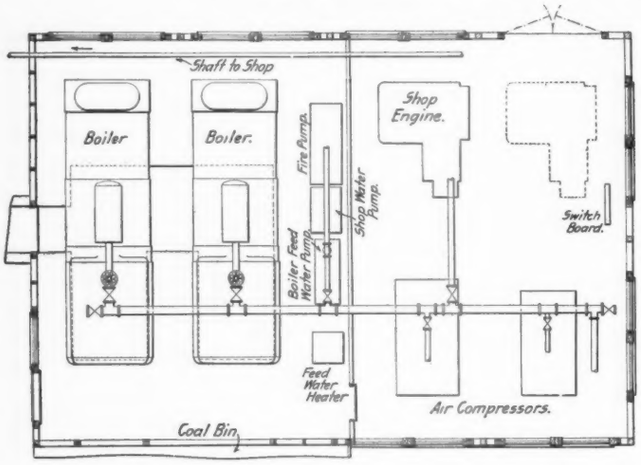


Fig. 3—Arrangement of Power House Equipment.

The new power house shown in Fig. 2 is much larger than the old one, and in it are installed two 350 h. p. stationary boilers of the Pennsylvania standard, which replace six old and worn-out locomotive boilers, tremendous coal eaters, and using thousands of gallons of water hourly, and yet not producing the power they should. Their general dimensions are as follows: Diameter, 96 in.; 314-3 in. flues; internal heating surface of flues, 3062.7 sq. ft.; heating surface of firebox, 251.3 sq. ft.; total heating surface, 3314 sq. ft.; grate area, 66 sq. ft.; steam pressure, 160 lbs.; size of firebox, 9 ft. x 7 ft. x 8 ft. They carry 125 lbs. pressure, but are rated at 160 lbs. The engine room contains two air compressors, a 700 k. w. generator, a shop stationary engine, a hot water heater, a fire pump, a cold water pump, and a hot water feed pump for the boilers. The general arrangement of the power house is shown in Fig. 3. Formerly the large stationary engine, one of the air compressors, two small generators and a small stationary engine were grouped in the engine room of the old machine shop, while the other air compressor, together with the fire pump and hot water pump, were located in an old power house some distance away. The cold water pump was placed at the extreme end of the engine house. The collection of these machines under one roof is a decided increase in efficiency.

A new steel water tank of 100,000 gals. capacity has also been erected just south of the power house, its height giving the water at the several stand pipes a decided increase in pressure. The old machine shop building was torn down completely, and all the machinery moved into the building which was formerly occupied by the blacksmith and boiler shops. The old machine shop building had been added to and enlarged at various times as the increase of business demanded, but it was of such an odd shape and so crowded with machines that the work was always much retarded. The problem of getting sufficient light was always a difficult one. Men cannot work to advantage in a poorly lighted shop, either by day or night, to say nothing of the increased hazard in handling the work at the benches and machines.

It was found that the blacksmith and boiler shop departments could be concentrated at one end of the building *G,* the general arrangement of which is shown in Fig. 4. This gave a clear floor space of 106 ft. x 43 ft. for the machine shop and furnished an opportunity to group the machines logically and to lay out the floor space to the best advantage for handling the work. An addition, 130 ft. long by 12 ft. wide, was added to the west side of the building to take care of part of the car wheel machinery, the foreman's office, a long work bench and the tool room. A wide aisle is provided through the center of the shop from end to end. A large number of overhead tracks and runways equipped with pneumatic lifts, besides some half dozen cranes, have been installed. Part of this overhead system pertaining to the handling of car wheels was shown in the Shop Section of

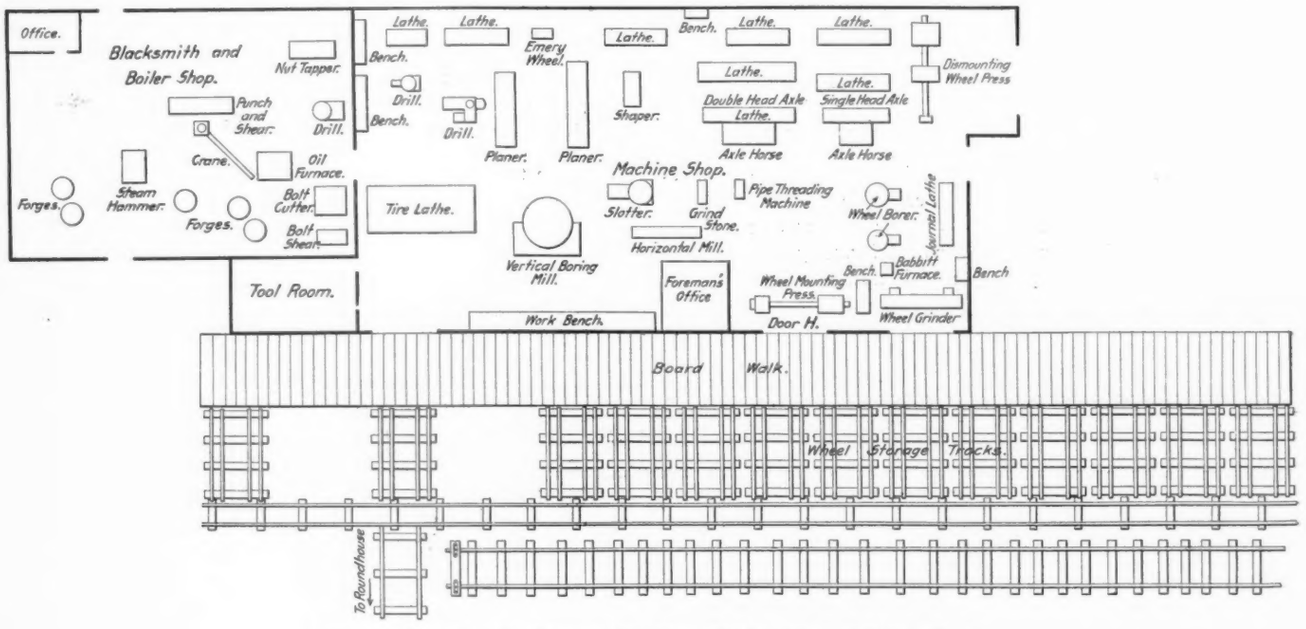


Fig. 4—Layout of Machines in Machine, Blacksmith and Boiler Shops.

the *Railway Age Gazette,* December 1, 1911, page 1136. On the same side of the building as the new addition, a sidewalk 12 ft. wide was built. This is now the thoroughfare connecting the engine house, machine shop and other buildings beyond, and is a marked improvement over the former narrow walk. It facilitates the handling and trucking of material to and from the storehouse, machine shop and engine house, an important detail in the interests of economy.

Extending out from, and at right angles to this board walk is a series of tracks for the storage of mounted wheels as they are rolled out of door *H* finished and ready for the cars or engines. There are 13 tracks, holding 117 pairs of wheels. A four-wheel truck running on a narrow gage track is located at the outer ends of these tracks. The floor of the truck is so arranged that a pair of wheels may be rolled on it from the storage tracks; the wheels are kept from rolling off by the flange dropping into square holes in the floor of the car. The truck wheels run on roller bearings, so it is an easy matter to push the truck along, and deliver a pair of wheels to the engine house, or at the opposite end of the track for loading. Further improvements will probably include a loading crane at the loading track.

The building used as a planing mill was formerly about 250 ft. long, as shown in Fig. 1. About 75 ft. of this was torn down and the balance of the building was moved some six hundred feet to the new location, shown in Fig. 2. A new roof was put on, new ends were put in and a new floor was laid. A Westinghouse high speed automatic engine of 90 h. p. was installed to furnish power. Here again an opportunity was presented to place the machines to better advantage than in the old location, and the result is a creditable shop in which everything is arranged to handle the output systematically and always in an outgoing direction.

The blacksmith and boiler shops have a floor space of 60 ft. x 43 ft., the arrangement of forges, steam hammers and other tools being shown in Fig. 4. The jib crane which formerly only served the punch and shear, has been so located that it now reaches one end of the oil furnace, one of the forges, the steam hammer and both ends of the punch and shear, thus more than doubling its usefulness and efficiency. A new iron rack has also been installed outside of the building.

New offices have been completed for the foreman of the car department and the corps of clerks in a more central location for the repair yards, mill and coach shop. There is also a locker room for the workmen in this building. Another improvement at present under way is a large sanitary washroom and rest room for the engine house forces. The general plan of improvement also includes the placing of four water columns to be operated from a steel bridge supported on concrete piers; it will be located just south of the shop yards. These columns will allow four locomotives to take water at the same time.

FUSIBLE PLUGS.—Pure tin makes the best filling for the fusible plugs of steam boilers, alloys being objectionable because those that have been tried for the purpose appear to undergo a gradual change when exposed continuously to heat, so that their melting points do not remain constant. Four closely accordant and apparently quite accurate determinations of the melting point of tin have been made, with the following results:

Date.	Observers.	Melting Point.
1892	Callendar and Griffiths	231.7 deg. C.
1895	Heycock and Neville	231.9
1900	Reinders	232.0
1902	Kurnakow and Puschin	231.5
	Average	231.8 deg. C.

This corresponds to 449.2 deg. Fahr. A tin-filled plug will not melt out from the natural heat of the steam until the pressure of the steam becomes 363.3 lbs. per sq. in.

COACH CLEANING.*

BY J. H. WHITTINGTON,
Master Painter, Chicago & Alton, Bloomington, Ill.

Terminal coach cleaning should be conducted according to a fixed system in order to insure the proper sanitary conditions. We use the following system for handling the different classes of this work. Class *A* should be made at the end of each trip. Class *B* should be done when the car is too dirty to await cleaning under Class *C*, which is a general cleaning given the car every three months. The instructions for each class of cleaning accompany this article. Forms are used in making the monthly reports which show the total number of cars cleaned in each class, together with the total cost per car. One copy is sent to the office of the superintendent of rolling stock, or to the officer who controls the car cleaning department, and one copy is placed on file in the office of the terminal foreman making the report.

When the car receives a class *C* cleaning the place and date are recorded on a small piece of cardboard, which is inserted in a small tin slide about 1¼ in. wide by 3 in. long located at some convenient place in the car. If the car has received a class *C* cleaning before, the old card is forwarded to headquarters and a new one is put in its place. This system enables the office of the superintendent of rolling stock to keep a close check on the work. It makes no difference on what part of the system, or at which terminal a car may be when this class *C* cleaning is due Each foreman must watch all cars to see that the three months are not overrun, and he must perform the work whether he has handled the car before or not. If there is any doubt as to the location of a car when the class *C* cleaning is due, the superintendent of car service can locate it. The following rules are followed for the different classes of cleaning:

Class A Cleaning.—All passenger equipment in regular service shall be thoroughly cleaned after each trip at such points as have been provided with the necessary facilities. That is, they shall be given a class *A*, or ordinary cleaning, such as dusting the car, seats and seat backs; removing, cleaning and replacing the aisle strips; cleaning out under the pipes, washing the window sills and the seat ends or arms, mopping the floor and cleaning the glass. Cuspidors should be washed with a solution of ½ pint of a good disinfectant to each 2 gals. of water used. The same solution should be used in the lower parts of the toilet rooms and the hoppers. Toilet rooms must be supplied with a sufficient amount of toilet paper. Water coolers should be emptied and washed out with scalding hot water and refilled with ice and water. Drinking glasses must be washed both inside and outside.

All cars requiring linen and soap must have a sufficient supply before leaving any terminal. All drip machines in toilet rooms shall be kept full of the drip fluid disinfectant. All lamps must be carefully looked after, cleaned, filled and put in good condition, the wicks being evenly trimmed. Ice-boxes and refrigerators in the cafe, dining or private cars shall be cleaned regularly after each trip. Air spaces in the provision boxes shall be kept covered with a perforated sheet of metal or wire netting to avoid anything falling in them where it cannot be easily removed. Special care must be taken in the method of cleaning the seat backs, cushions, curtains, carpets, etc., whenever it is necessary to do so. Vacuum cleaning is preferred in all cases. All brass and metal work must be cleaned and polished; the interior and exterior of the car and trucks, such as the steps, gas tanks, boxes, truss rods and other noticeable parts, shall be wiped regularly after each trip. Do not use oily waste on opalescent glass; wipe it with clean dry waste.

See that all the cars, equipped with either gas or electricity, have the gas tanks filled or the batteries sufficiently charged and that all the lights are in perfect order. The chair cars must have clean hoods or head rests put on at the end of each trip; all torn

*Entered in the *Railway Age Gazette* competition on Paint Shop Practice, which closed November 15, 1911.

and ragged hoods must be removed and replaced with new ones. The carpets in the dining, cafe or private cars must be removed and the floor mopped up with a disinfectant solution. The carpets must be thoroughly cleaned either by air or vacuum before they are put back in the car.

After an official or private car has completed a trip on an inspection tour, or with a private party, it must have special attention. Remove all the provisions. Close all the openings and thoroughly disinfect the interior of the car, after which remove all the linen, draperies, carpets, etc., and have them cleaned and ready to be put back in the car as soon as it has been cleaned. If the car is not wanted for service at the completion of this operation, roll up the carpet and put it in car, but do not put it down in place until the car has been ordered out of service. If this is done it will save numerous complaints caused by careless and indifferent persons walking through the car and not realizing the damage that may be done with dirty shoes.

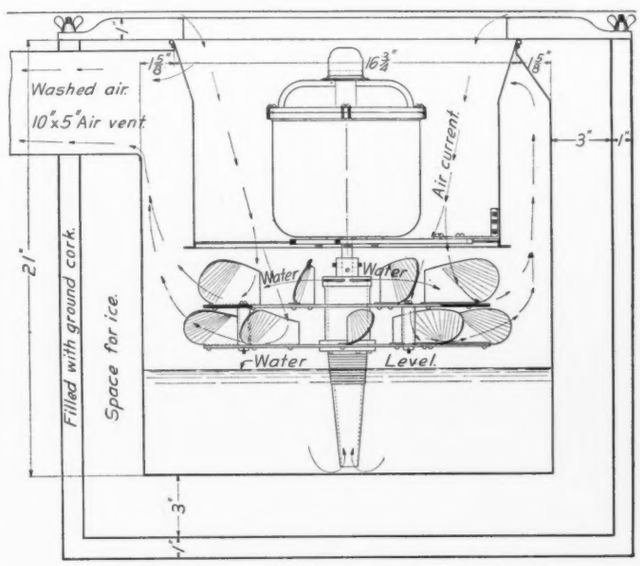
Class B Cleaning.—This class consists of cleaning the outside of the body and washing the inside, if necessary. The operations are as follows: One man applies one gallon of shop cleaner with a car washer's brush having a handle 7 ft. long, commencing at the end of the car on the bottom and working up to the top of the letter board, being careful to get the cleaner in all of the corners. When about 12 or 15 ft. of the body of the car has been covered, another man should start with a brush and water and thoroughly wash off the cleaner. This may be done with a fountain brush or by dipping a brush in a bucket of water. When the car is dry, two men with trestles, plank and a good handful of waste well saturated with varnish renovator and squeezed out, should rub the surface well and evenly, and then wipe it dry, cleaning the glass as they go along. When a car is receiving class *B* cleaning, the headlining may be scrubbed with a good cleaning compound, using a brush and wiping it off with waste. This will carry the car through with pleasing appearance until a class *C* cleaning is due. When the headlining is cleaned it must be mentioned under "remarks" on the report form, giving the number of the car. Ceilings in the mail and baggage ends of combination cars must be scrubbed with soap and washed with water.

Class C Cleaning.—This class consists of a thorough cleaning of both the interior and the exterior of the car, and should be done every 3 months as follows: For the outside of the body, sash and glass, one man, with a gallon of shop cleaner and a car washer's brush with a long handle, should start at the end of the car and apply the cleaner, beginning at bottom of car and working up to top of letter-board, brushing the cleaner on evenly and in all the corners. When about 12 or 15 ft. of the car has been covered with the cleaner, another man with a bucket and a fountain brush should start to wash off the cleaner, letting the first man applying it keep about the same distance ahead to allow the cleaner time to soften up the dirt before it is washed off. When the cleaning process has been completed and the car is dry, two men should oil and wipe it off by thoroughly saturating a handful of waste in a varnish renovator, squeezing it out as dry as possible, and taking care to cover every part of the surface. Then wipe thoroughly with dry waste.

The glass may be cleaned at the same time to avoid going over the car a second time. Trucks, steps, gas tanks and supply boxes under the car must be cleaned in the same way. The interior of the vestibules must be cleaned in the same way as the outside of the body of the car. For interior cleaning, when the car is not very dirty, the headlining and all the wood work must be scrubbed with a brush, using a good cleaning compound and then wiping dry with waste. If it is very dirty and the dirt is hard to remove, use a scrub brush and 1½ lbs. of soap to a gallon of water. Then wash off with clean water, and oil all the wood work with a renovator, wiping it thoroughly dry with waste. Wash the floor, cuspidors and hoppers, and spray the floor and the bottom parts of the toilet rooms and cuspidors. All upholstered seats and backs must be blown or dusted out before the car is washed and oiled. All dining or private car food boxes, refrigerators, closets, drawers and cupboards should be washed with scalding hot water and treated with one or two per cent. solution of formaldehyde. The seat backs, aisle strips, water coolers, lamps, ice boxes, refrigerators, cuspidors and hoppers must have the same attention as in a class *A* cleaning.

AIR WASHER AND COOLER FOR PASSENGER CARS

The cars in the Santa Fe "Train de Luxe" are equipped with an air-washing and air-cooling apparatus which is intended to be used when passing over hot, dusty portions of the line. This device, which occupies only a small space, is located in a closet at the ends of the dining, sleeping and buffet cars, and consists of a sheet iron receptacle partially filled with water around which is a 3-in. space filled with ice, all enclosed in an insulated metal box. A small electric motor is suspended in a metal cylinder, open at the top and bottom, which forms the passage for the admission of air to the fan below. The motor is especially wound to be operated on the lighting circuit and runs at 1,200 revolutions per minute. The fan is 16 in. in diameter and ends in a small conical tube which projects into the water as is shown in the illustration. The rapid revolution of the fan



Air Washer and Cooler for Passenger Equipment.

causes the water to rise in the tube, and as it passes out through a narrow slot near the top of the fan it is caught by the upper series of blades and dashed into a spray. Air from the outside is drawn in by the fan through the central portion around the motor and after passing through the cold water spray is delivered to the car through ducts arranged in the lower deck. A number of 8-in. registers in the head lining distribute it through the car body.

This apparatus has a capacity of washing and cooling 90,000 cu. ft. of air per hour, which will greatly add to the comfort of the passengers passing through hot dusty regions. The device is made by the Duntley Manufacturing Company of Chicago.

Mineral Products in the United States.—The United States Geological Survey has issued a table giving the production of mineral products in the United States for the past ten years. The total value of mineral products in 1910 was $2,003,744,869 as against $1,886,772,843 in 1909. The highest record made was in 1907, which shows a total value of $2,071,613,741.

POWERFUL MIKADOS FOR THE ERIE RAILROAD

As Part of the Program for Relieving Traffic Congestion on the Cincinnati Division, the Erie Has Purchased 35 Locomotives of the 2-8-2 Type Sufficiently Powerful to Increase the Tonnage Per Train About 38 Per Cent.

The increase of business on the Cincinnati division of the Erie, particularly between Marion Junction, Ohio, and Kent, a distance of about 112 miles, had so congested traffic as to make the operation inefficient and unsatisfactory. This was originally a single track division and following the methods used on other parts of the system, the application of which resulted in wonderful improvement in the speed and expense of handling tonnage, a careful and systematic study was made of all conditions to determine exactly what changes were advisable to bring the division to a high state of operating efficiency. As a part of the results of this study it was decided to replace the consolidation locomotives by heavier power capable of handling heavier trains at higher speeds. Double tracking was also specified and practically the whole division is now provided with double track. Changes in yards and terminals also formed part of the program. The class H-21 consolidation locomotives had a maximum tonnage of 1,050 tons westbound and 1,100 tons eastbound, from Kent to Marion Junction, a profile of which is shown in one of the illustrations. These locomotives have been for many years the standard freight engines of the Erie, and have the dimensions shown in the accompanying table.

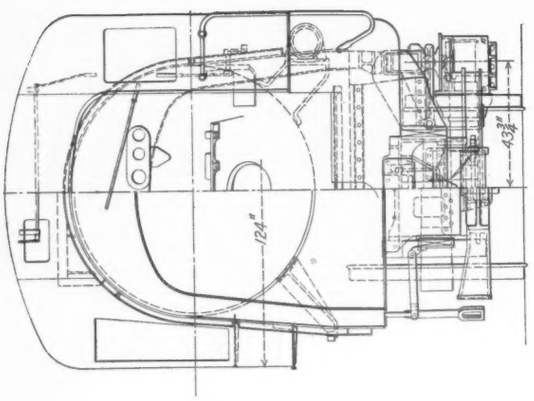
In considering the problem of new power, a most careful study was made of the advantages offered in this particular district by a powerful mikado type and two different types of Mallet locomotives; the decision finally reached favored the mikado for several reasons. For one thing, it seemed advisable to be prepared to handle traffic at a higher speed than it was felt the Mallet could be suitably designed to give. It was also found that the necessary incidental changes and improvements such as longer side tracks, revised terminal and yard arrangements, as well as engine houses, shops, and in some cases bridges, were sufficient to practically offset the reduction of operating expenses procurable with that type.

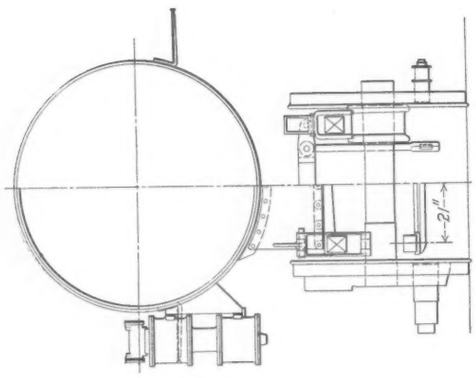
Having decided on the 2-8-2 wheel arrangement, designs were made in the mechanical engineer's office for a locomotive which would handle 1,450 tons westbound and 1,520 tons eastbound over the section of the division from Kent to Marion Junction, this being an increase of about 38 per cent. in tonnage. To handle these trains at fairly high speeds, it was found that practically the maximum weight procurable with four sets of drivers would be required. The locomotive, as finally designed, has an average weight of nearly 60,000 lbs. per driving axle. Thirty-five of these locomotives were ordered, twenty from the Baldwin Locomotive Works and fifteen from the American Locomotive Company. The former have been delivered and are proving themselves capable of all that was expected from them. The locomotive is exceptionally large and strong in all of its parts. It will be seen that while it is in general based on straightforward, well-established designs, containing no frills, advantage has been taken of many of the proved features leading to economy of operation. The Schmidt superheater of large size in connection with outside steam pipes is used. Security brick arches have been specified and the locomotives are fitted with the Pilliod valve gear.

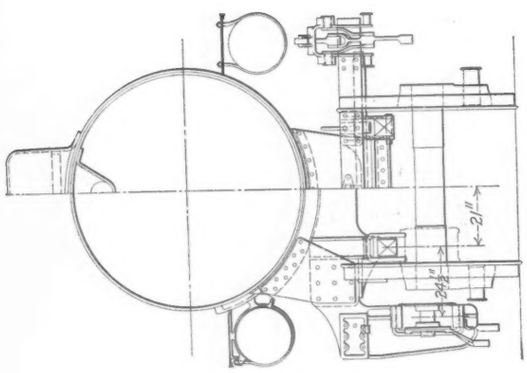
Powerful Mikado Locomotive with Superheater and Pilliod Valve Gear; Erie Railroad.

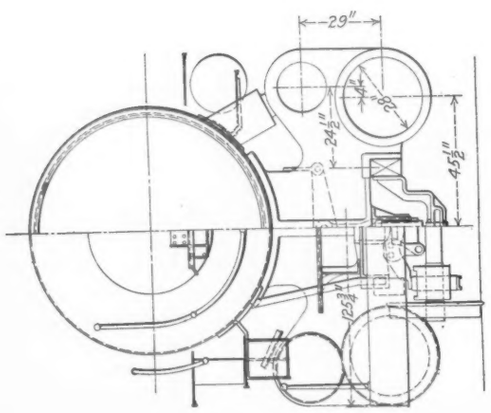
GENERAL DIMENSIONS OF CONSOLIDATION LOCOMOTIVES.

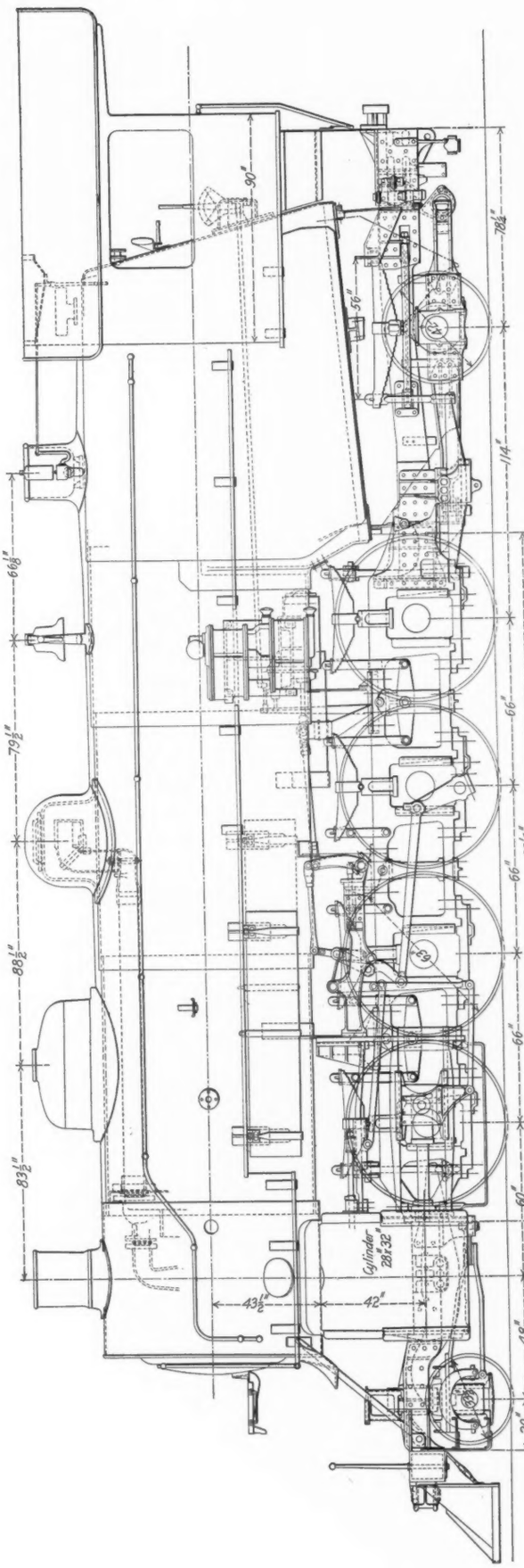
Class	2-8-0
Tractive effort	42,500 lbs.
Weight in working order	200,700 lbs.
Weight on drivers	176,400 lbs.
Wheel base, rigid	17 ft.
Wheel base, total engine	25 ft. 11 in.
Cylinders, diameter and stroke	22 in. x 32 in.
Diameter drivers	62 in.
Driving journals, main	9½ in. x 12 in.
Driving journals, others	9 in. x 12 in.
Steam pressure	200 lbs.
Number and diameter of tubes	380—2 in.
Length of tubes	16 ft.
Heating surface, firebox	174 sq. ft.
Heating surface, tubes	3,165.7 sq. ft.
Heating surface, total	3,339.7 sq. ft.
Grate area	54 sq. ft.











Mikado Locomotive Specially Designed for Use on the Cincinnati Division of the Erie.

The accompanying table gives the general dimensions and some of the more important ratios of five recent designs of the 2-8-2 type, permitting a comparison with this design and the others. It will be seen that the Erie engine is the heaviest in total weight and on drivers, and also that it has the smallest percentage of the total weight on the drivers. In other respects, as regards size, it is very similar to the Great Northern design. Comparing the Erie and Great Northern engines directly it is seen that the former is of considerably greater weight for practically the same power and, judged on the basis of heating surface, it has a smaller boiler. A more careful study of the details, however, shows that the greater total weight is largely accounted for in three features; first, the use of frames in 6 in. in width as compared with 5 in. in the Great Northern; the 84 in. boiler has sheets 15/16 in. in thickness as compared with an 82 in. boiler with ⅞ in. sheets on the Great Northern; there is a smaller number of 2¼ in. tubes giving a considerably greater water capacity and hence increased weight in the boiler. The Erie superheater has 36 elements as compared with 30 in the Great Northern, but the tubes in the latter case are 1⅝ in. diam. as compared with 1 7/16 in. on the Erie. The ratio of superheating surface to evaporative surface, is considerably larger on the Great Northern, due to the larger number of boiler tubes. One very striking difference in the two designs is found in the 13 in. piston valves on the Great Northern as compared with 16 in. on the Erie.

COMPARATIVE DATA FOR RECENT MIKADO LOCOMOTIVES.

Road	Erie.	B. & O.	M. P.	G. N.	I. C.
Total weight, lbs.	320,600	274,600	275,000	287,000	283,850
Weight on drivers, lbs.	237,150	219,000	209,500	220,000	218,300
Percentage of weight on drivers	74	80	76.3	76.5	77.1
Average weight per axle, lbs.	59,288	54,750	52,375	55,000	54,575
Tractive effort, lbs.	57,460	50,200	50,000	57,460	51,700
Diameter drivers, in.	63	64	63	63	63
Steam pressure, lbs.	170	205	170	170	175
Diam. boiler, front ring, in.	84	78	75¾	82	82
No. and size of tubes	232—2¼	389—2¼	224—2	326—2	262—2
No. and size of flues	36—5½	.....	30—5⅜	30—5½	36—5⅜
Length of tubes, ft. & in.	21	21	16—6	21	20—6
Evaporative heating surface, sq. ft.	4,155	5,017	2,868	4,720	4,068
Superheater heating surface, sq. ft.	1,050	.....	558†	1,060	1,093
Equivalent heating surface, sq. ft.*	5,730	5,017	3,705	6,310	5,708
Grate area, sq. ft.	70	70	49.5	78.2	70
Evaporative heating surface ÷ superheating H.S.	3.95	.....	5.15	4.45	3.72
Cylinders, diameter and stroke, in.	28 x 32	24 x 32	27 x 30	28 x 32	27 x 30
Diameter valves, in.	16	14	.....	13	15
Valve travel, in.	6	.....	6	6	6½
Lap of valve, in.	1	.....	1	1⅛	1¼
Lead, in.	¼	.....	3/16	3/16	¼
Total weight ÷ equiv. H.S.	56	43.8	74.3	45.4	49.5
Total weight ÷ tractive effort	5.6	5.47	5.50	4.98	5.50

*Evaporative heating surface plus 1.5 times superheater heating surface.

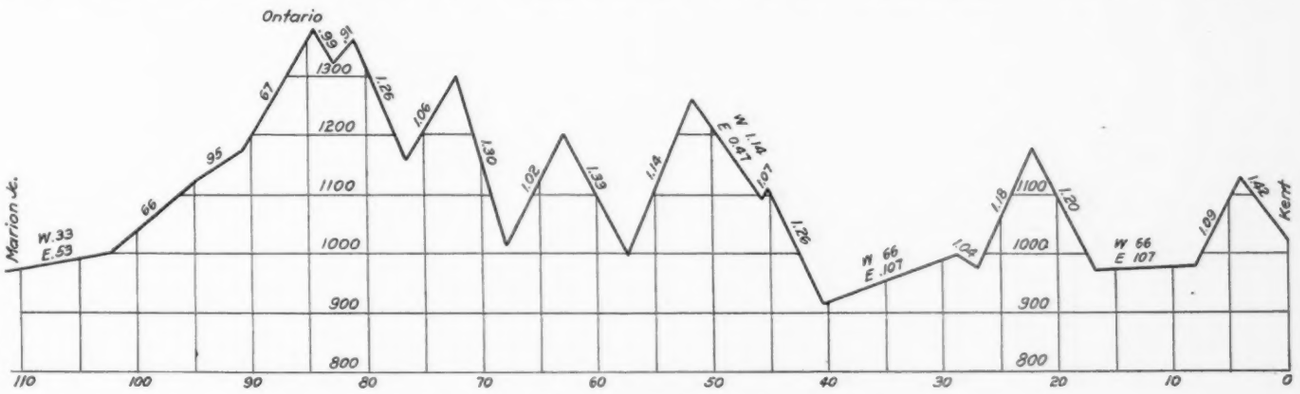
†Figured on inside of superheater tubes.

located about the centre of the barrel. The diameter at the front ring is 84 in., which is increased to 87¾ in. outside diameter at the firebox. The seams of the barrel are all placed at the top center line, are welded at the ends and have diamond shaped welt strips inside. The dome with its base, in spite of the fact that it is 22 in. high, is flanged from one piece of steel plate. The mud ring is 6 in. in width on all sides. A single fire door is used. The throat sheet has a depth of 25 in. below the barrel, giving ample space for the brick arch, which is supported on four 3 in. water tubes. Flexible staybolts have been used at both ends of the side sheets, and the front of the crown sheet is supported by four rows of flexible stays. Provisions have been made to allow the application of an automatic stoker.

Cylinders.—One of the illustrations clearly shows the design of the cast iron cylinders which are arranged for use with the outside steam pipes. It will be seen that the casting is well braced; passages are liberal and the construction follows approved lines.

Frames.—Vanadium steel frames, 6 in. wide and with a depth of 7 in. over the pedestals have been specified for these locomotives. Their appearance gives confidence in the minimization of frame breakage. The single trailer truck frame of wrought iron is spliced to the main frames just back of the fourth pedestal. The frames are arranged for the securing of the spring links by pins through holes in the frame castings between the second and third pedestals, where the equalization system is divided.

Valve Gear.—While the studies were being carried on leading up to the design of this locomotive, practical tests were being made with the Baker-Pilliod valve gear. Following the formal tests, records were kept of two locomotives for a period of about a year with the result that it was decided to specify this type of valve gear on all of this order of locomotives.† The year's experience indicated that not only could considerable economy in fuel be expected, but also that the maintenance and repair charges of the valve gear would be decidedly reduced. The power reverse gear is being fitted to all of the locomotives not because any difficulty would be experienced in reversing by hand, as it has been found that this type of valve gear has considerable advantage in this respect, but beacuse it was almost impossible to suitably locate a quadrant in the cab. Even as now arranged there is some congestion of apparatus in the cab, and the addition of the reverse lever with its quadrant would be decidedly objectionable.



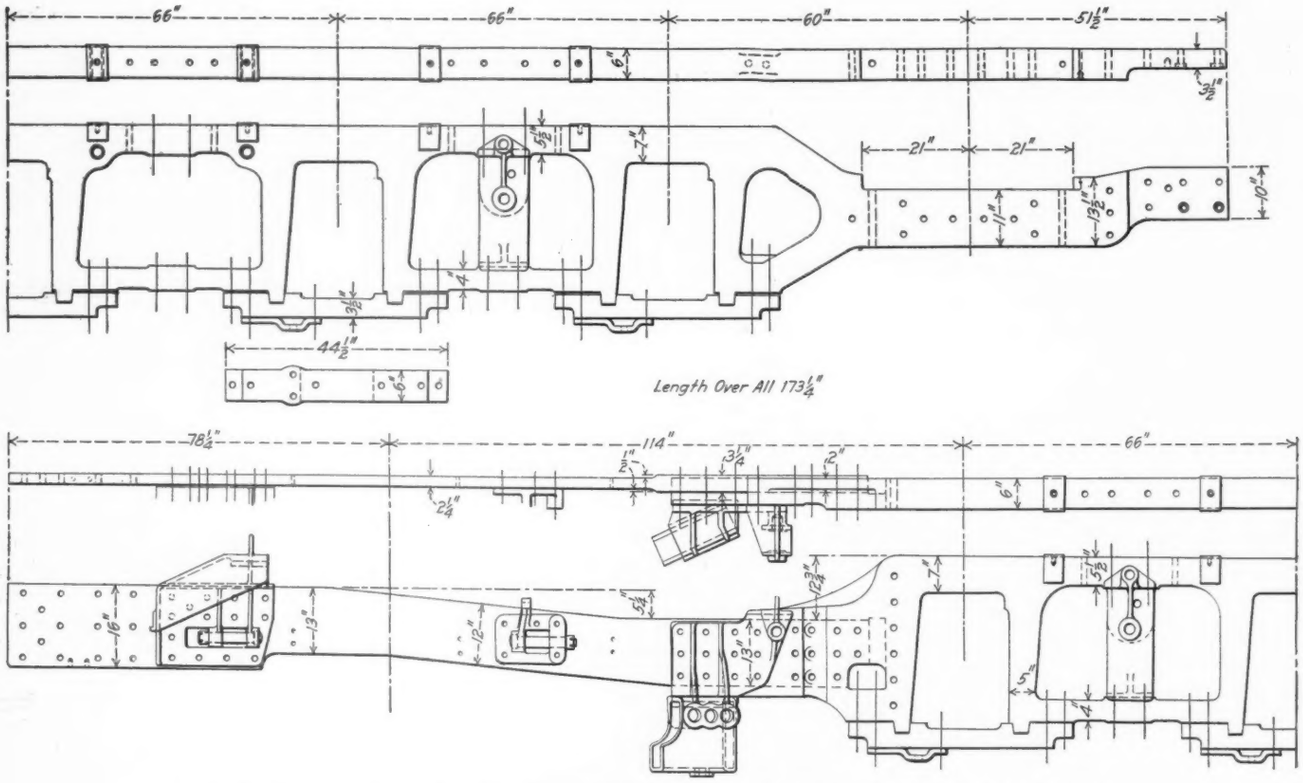
Profile of Erie Railroad from Kent to Marion Junction.

Boiler.—As mentioned above, the boiler carries a pressure of 170 lbs. It is of the conical radial stay type, having the dome

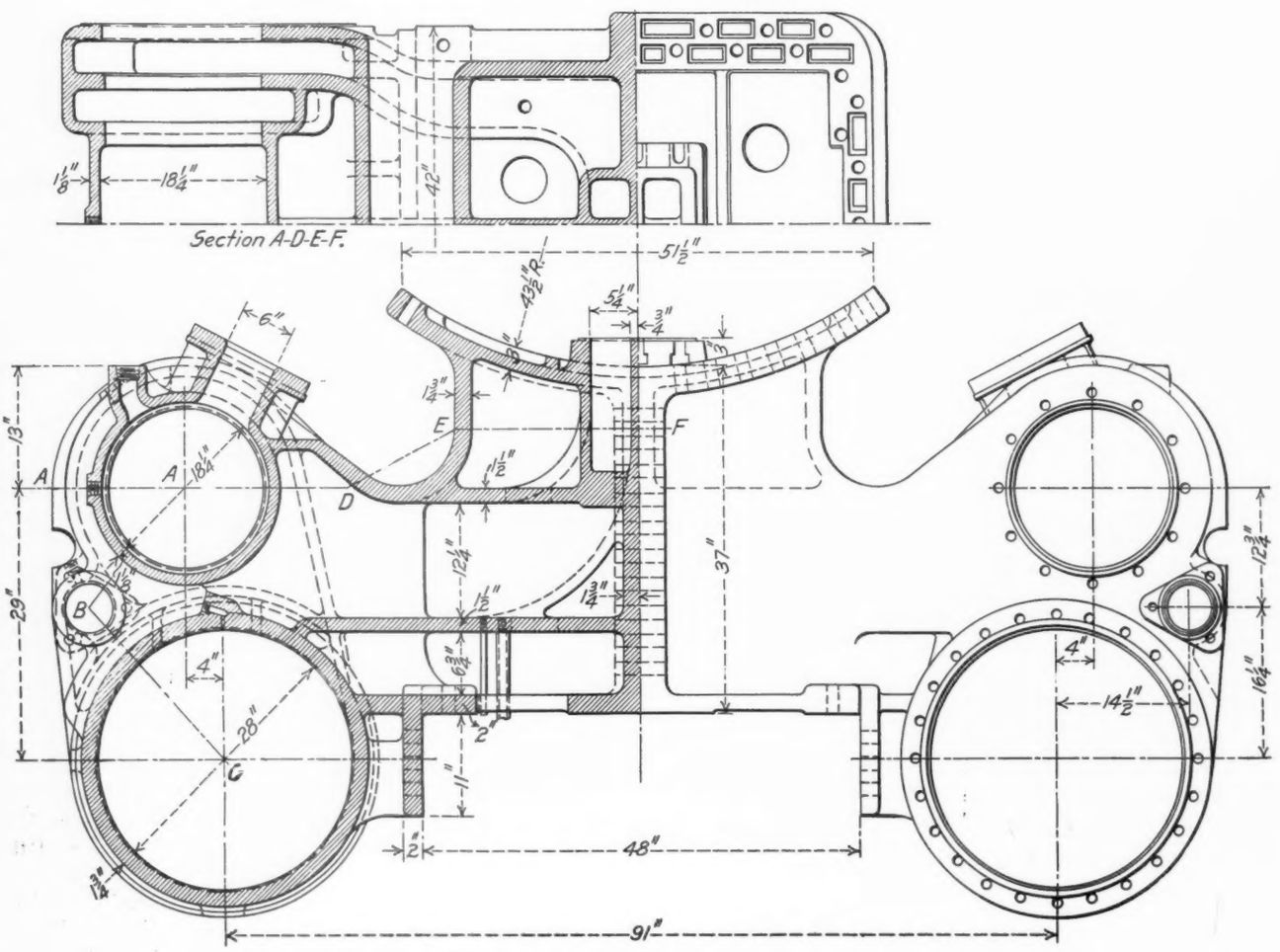
Trailer Truck.—The latest improved arrangement of outside bearing, radial trailer truck, as designed by the American Locomotive Company, has been specified on these locomotives. This was fully described on page 10 of the January issue of this journal.

Tender.—For the purpose of obtaining the maximum of capacity with the minimum of weight, the Vanderbilt type of tender

†For fully illustrated description of this valve gear see *American Engineer*, November, 1910, page 442.

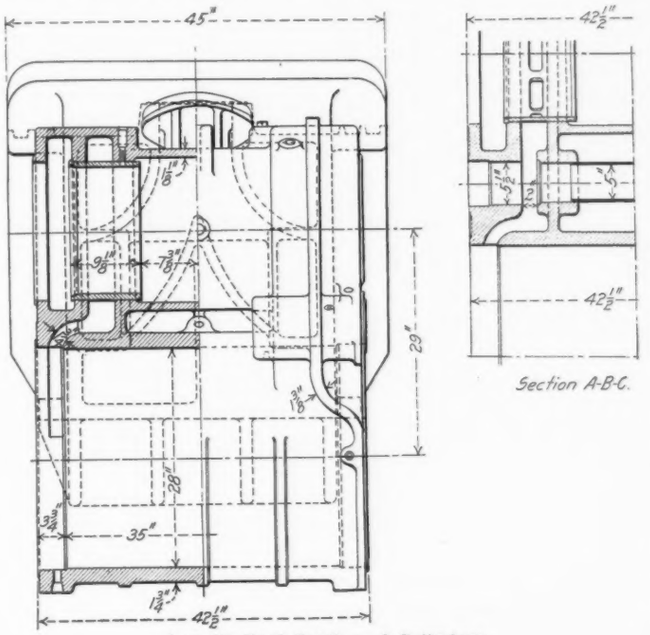


Vanadium Steel Frames of Very Large Cross Section Have Been Applied to the Erie Mikados.



Cast Iron Cylinders Arranged for Outside Steam Pipes, Erie 2-8-2 Type Locomotives

has been used. It has a water capacity of 9,000 gals. and coal capacity of 16 tons, and weighs about 57,000 lbs. light. The tank has a diameter of 8 ft. 9 in., and the underframe is composed of 6 in. x 4 in. angles with cast steel end sills.



Longitudinal Section of Cylinders.

The general dimensions, weights and ratios of these locomotives are given in the following table:

General Data.

Gage	4 ft. 8½ in.
Service	Freight
Fuel	Bit. coal
Tractive effort	57,460 lbs.
Weight in working order	320,600 lbs.
Weight on drivers	237,150 lbs.
Weight on leading truck	29,600 lbs.
Weight on trailing truck	53,850 lbs.
Weight of engine and tender in working order	483,000 lbs.
Wheel base, driving	16 ft. 6 in.
Wheel base, total	35 ft.
Wheel base, engine and tender	66 ft. 10½ in.

Ratios.

Weight on drivers ÷ tractive effort	4.11
Total weight ÷ tractive effort	5.58
Tractive effort × diam. drivers ÷ heating surface*	629.00
Total heating surface* ÷ grate area	82.00
Firebox heating surface ÷ evaporative heating surface, per cent	5.25
Weight on drivers ÷ total heating surface*	41.30
Total weight ÷ total heating surface*	55.90
Volume both cylinders, cu. ft.	22.78
Total heating surface* ÷ vol. cylinders	252.00
Grate area ÷ vol. cylinders	3.08

Wheels.

Driving, diameter over tires	63 in.
Driving, thickness of tires	3½ in.
Driving journals, diameter and length	11 in. x 14 in.
Engine truck wheels, diameter	33½ in.
Engine truck, journals	6 in. x 12 in.
Trailing truck wheels, diameter	42 in.
Trailing truck, journals	8 in. x 14 in.

Boiler.

Style	Conical
Working pressure	170 lbs.
Outside diameter of first ring	84 in.
Firebox, length and width	120 in. x 84 in.
Firebox plates, thickness	⅜ in. and ⅝ in.
Firebox, water space	6 in.
Tubes, number and outside diameter	232—2¼ in.
Flues, number and diameter	36—5½ in.
Tubes, material	Iron
Flues, material	Steel
Tubes, length	21 ft.
Heating surface, tubes	3,936 sq. ft.
Heating surface, firebox	219 sq. ft.
Heating surface, total	4,155 sq. ft.
Superheater heating surface	1,050 sq. ft.
Grate area	70 sq. ft.

Cylinders.

Kind	Simple
Diameter and stroke	28 in. x 32 in.

*Equivalent heating surface = 5,730 sq. ft.

Valves.

Kind	Piston
Diameter	16 in.
Greatest travel	6 in.
Outside lap	1 in.
Inside clearance	1/16 in.
Lead in full gear	¼ in.

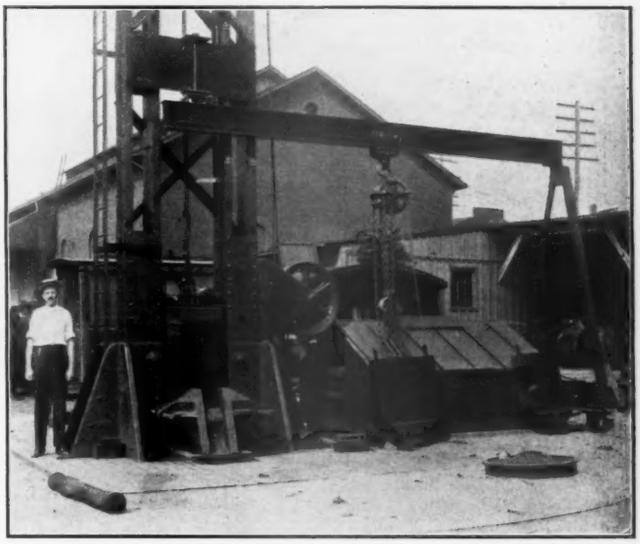
Tender.

Tank	Vanderbilt
Frame	6 in. x 4 in. angles
Weight, light	57,000 lbs.
Wheels, diameter	33 in.
Journals, diameter and length	6 in. x 11 in.
Water capacity	9,000 gals.
Coal capacity	16 tons

60-FOOT DROP TESTING MACHINE

BY ANDREW LAUTERBACH.

A new drop testing machine which has a clear drop of 60 ft., with a working space of over 30 in. between the guide rails, has been erected at the Mt. Clare shops of the Baltimore & Ohio for the use of the test bureau. Tups of three different weights are provided, permitting the machine to be used for practically all classes of drop testing work. A magnet using 550 volt direct current and having a lifting capacity for 16,000 lbs. is used for hoisting the tups. The current is delivered to the magnet by a flexible cable which passes over the top sheave and is wound on a drum of the same size and on the same shaft with that used for the hoisting cable. The hoisting is done by a 25 h. p. series wound motor, geared to the drums and provided with an emergency electric band brake, which will be described later. This apparatus is located about 7 ft. from the column and is enclosed.



New Drop Testing Machine; Baltimore & Ohio.

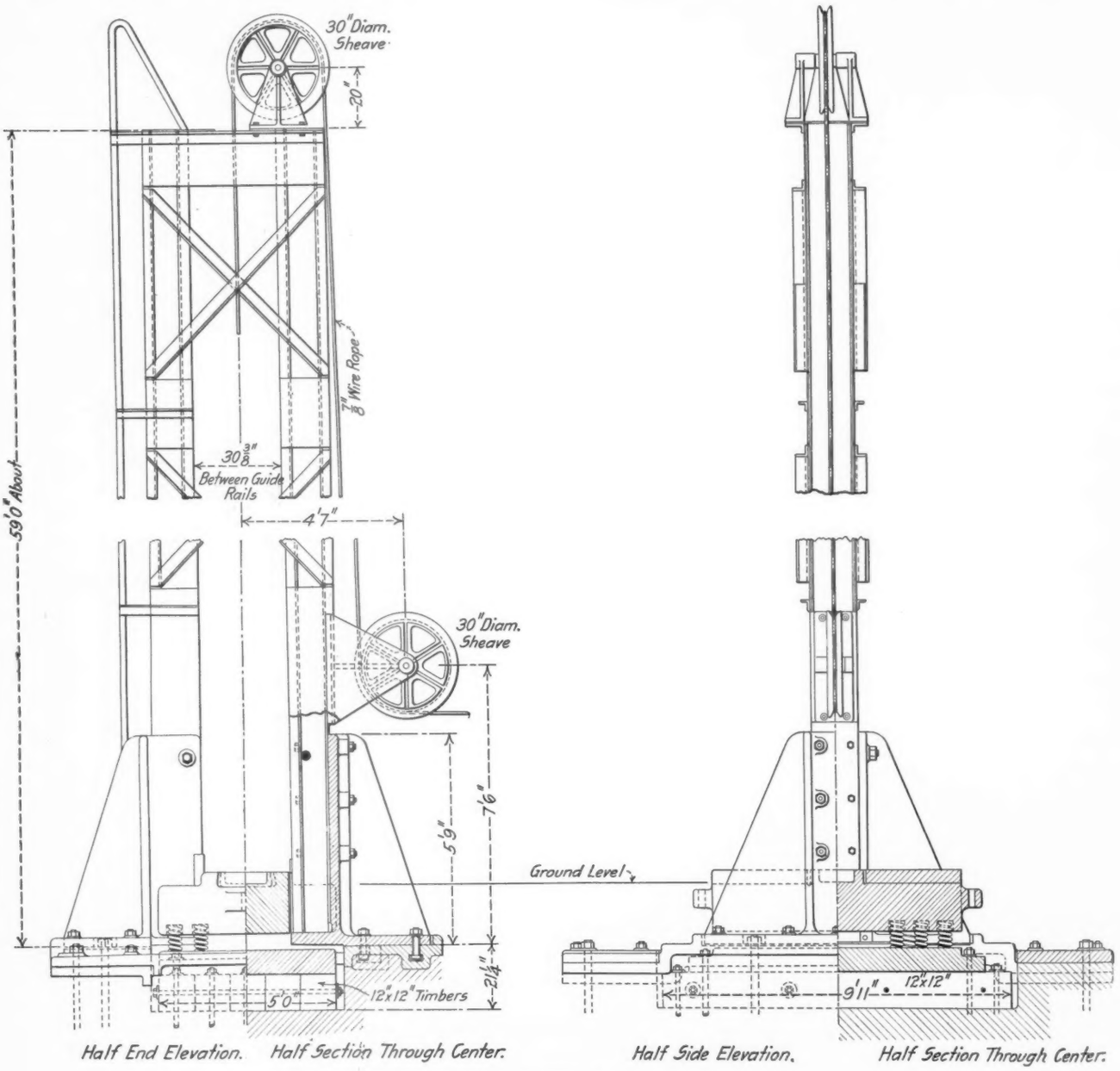
The operation is controlled from a small house about 70 ft. from the drop testing machine, where the operator has a full view of the machine. In this are located the necessary controller, switches, meters, pilot lamps, etc., for the hoisting and dropping of the tups.

Of the three tups, two are of forged iron, one weighing 1,640 lbs. for M. C. B. requirements and having two removable dies, and the other of 2,000 lbs. weight for rail testing, having a 5-in. radius striking face on the die. These two tups are about 7 in. thick. The third one is of cast iron, having a total weight of 9,000 lbs. for use in shearing tests on draft gear. This tup is seldom dropped over 3 ft.

Concrete, capped with 12 in. x 12 in. timbers, forms the foundation on which the base plate rests. The anvil casting is supported on a large number of coil springs, and the top of the anvil is arranged to come at about the ground level, avoiding unneces-

sary lifting and facilitating observation during the tests. The structural columns are made up of 15 in., 33 lb., channels placed back to back and braced and secured by angle iron diagonals as shown in the illustration. The bottom diagonals are bolted in place so that they may be removed, permitting the 9,000 lb. tup to be put into place. Although the present maximum drop required is but 49 ft., the columns are designed for a 60-ft. drop to provide for future specifications. Heavy angles are secured across the columns near the top for fastening the ½-in. guy ropes, has been used at the bottom because of the danger of breaking the standard rail, due to the rebounds and side thrusts.

A heavy plate properly formed to fit between the guide rails carries the lifting magnet and the safety catch arrangement. To the top of this plate is secured the hoisting cable which, together with the electric cable, passes over the double sheave at the top of the column, this sheave being of the proper size to permit the down running section to pass outside of the column to sheaves near the bottom, from whence they pass to the hoisting drums.



Sixty-foot Drop Testing Machine for the Baltimore & Ohio.

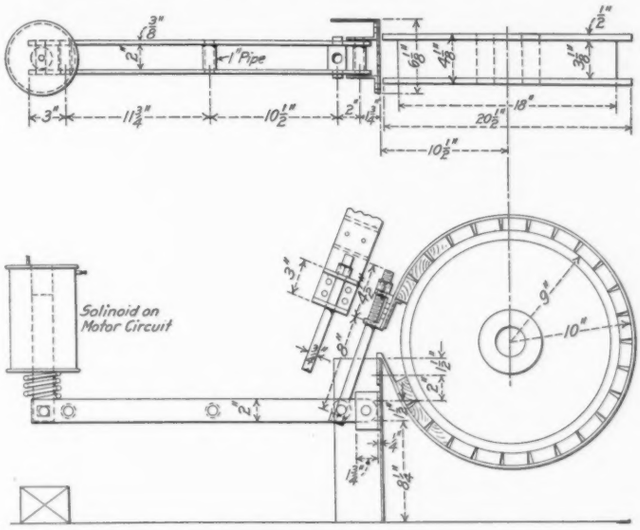
of which there are four, one at each corner. The bottoms of the columns are secured to special castings by bolts, arrangement being made to protect the bolts from falling pieces of broken rail, etc.

From the top of the column to a point about 10 ft. from the bottom, the guide rails are standard 30-lb. rails, 3 in. high, but from this point to the bottom each guide rail is made up of 2, 3 in. x 2½ in. x 11/16 in. angles, placed back to back. This distance is divided into three sections, any one or more of which may be removed for changing the tups. This type of guide rail

On the hoisting apparatus is a band brake operated by a solenoid connected in the motor circuit. The lever arm of the band brake is held in place, i. e., in the application position, by a coil spring, the effect of which is overcome by the solenoid when it is energized, thus releasing the brake. The construction at this point is shown in one of the illustrations.

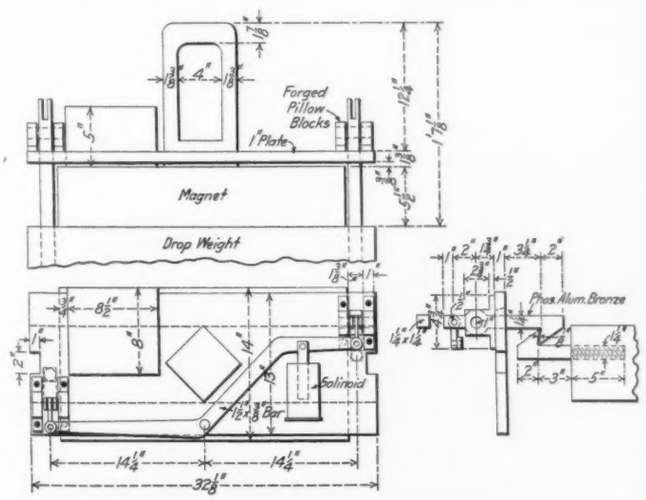
A solenoid is also used for operating the safety devices in connection with the lifting magnet. Here there are two aluminum bronze hooks, one each at diagonal corners of the plate, which interlock with forged hooks on the tups. When the tup is held

by the magnet there is ⅛-in. clearance between these hooks, as is shown in one of the illustrations, and in case of an accident or failure of the current leading to the lifting magnet, the tups would be prevented from falling by these hooks. They are forced out of line with each other by the energizing of the solenoid connected to them as shown. It will thus be seen that it is impossible for an electric failure to cause any damage since the band brake of the hoisting drum will be applied when the current fails, and the tups will be held by these safety hooks when the magnet is de-energized.



Automatic Band Brake on Hoisting Drum of Drop Testing Machine.

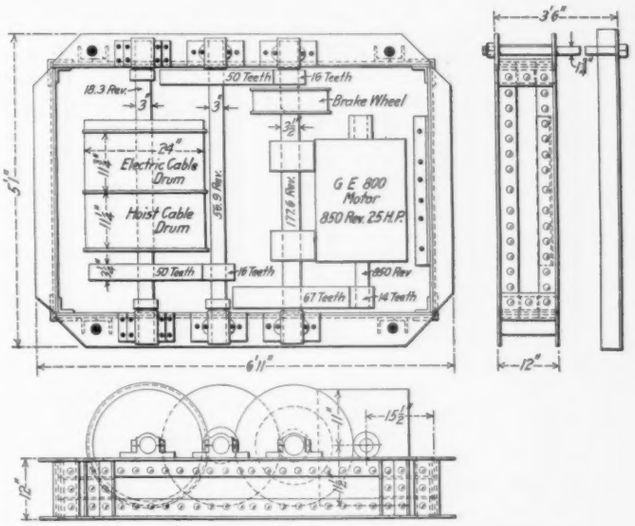
On the flange of the inside channel of one column, commencing about 12 ft. from the ground level, graduations one foot apart are painted, running up to the 25-ft. mark. From this point on the flange of the outside channel there are similar graduations running down to a point opposite the zero mark. A pointer attached to the hoisting cable is set at zero when the material to be tested is in place, and if a drop of greater than 25 ft. is desired there is another pointer attached to the down running section of the cable which comes into action and indicates all heights up to 50 ft., thus bringing all graduations for height within convenient view. It will be seen that with this apparatus there is no necessity for setting trips or for climbing the ladder on the side of the column for any purpose.



Safety Hooks on Hoisting Magnet.

A gantry crane is provided for handling the tups and material in and out of the drop. It consists of a beam pivoted from the column, the outer end of which is carried by an A frame running on a circular track 17 ft. in radius. The pivot is 15¼ in. from the end of the beam, permitting it to project between the columns and over the center of the drop. Before starting the test the crane is of course swung around to one side so that the beam will clear the tup. The two smaller tups have holes drilled in the top near the center so that bolts may be put in for handling, and the larger one has pockets cored in it for the same purpose. The wedges holding the dies are secured in place by plates placed over the joints.

After the material has been put in place and the proper tup has been set in the guides and the pointers set, the operation of testing is done by one man in the testing house as follows: The magnet is lowered to bear on the tup by reversing the hoisting motor by means of the controller in the operating house. A four point snap switch is then used. The first point makes connections for energizing the magnet only. (The safety hooks go into operation automatically as the magnet is lowered on the tup.) The hoisting motor is then started and the tup is raised to the desired height. The switch is then thrown to point 2, which energizes the solenoid on the magnet, pulling the safety hooks clear and at the same time de-energizing the magnet, permitting the tup to drop. Position 3 on the switch is not used, and position 4 is the "off" position, furnishing no current to the magnet or hook solenoid. The safety hooks on the magnet are made of aluminum bronze so as not to be attracted magnetically by the forged hooks in the tups when in contact with the magnet.



Arrangement of Electric Hoist for Drop Testing Machine.

All work except the foundation castings was prepared at the Mt. Clare shops of the Baltimore & Ohio, and the designs outside of the electrical features were prepared by the writer. The electrical features were designed by R. R. Stabler of the test bureau.

WAGON ROADS IN U. S.—The Secretary of Agriculture reports that there are in this country 2,210,857 miles of wagon roads, of which only 8½ per cent. are improved; but in 1904 only 7.13 per cent. were improved, the increase in the five-year period, 1904-1909, being 34,379 miles. The Office of Public Roads, a bureau of the department, has during the past year built, at local expense, object-lesson roads in 52 places, for which the sum of $120,000 was expended. Expert advice on road work has been given in 183 cases, scattered throughout 30 states. The agents of the department who have traveled over the country to investigate road building have given also 723 lectures in 35 states, which have been attended by 200,000 persons, mostly farmers.

EFFECT OF FIREBOX VOLUME ON COMBUSTION

The Value of an Increased Ratio of Firebox Volume to Grate Area and of Baffling the Gases Has Been Proved in a New Type of Firebox.

BY F. F. GAINES

Superintendent of Motive Power, Central of Georgia.

In the study of the combustion of fuel in locomotive boilers, it would seem as if the value of firebox volume and heating surface had been to some extent lost sight of, or at least had not been given the weight that it deserves. It would also seem that the effect of changing the path of the gases in the firebox by means of either the brick arch or the combustion chamber with a brick wall has not been appreciated to the extent that it should be. While it is true that a few railways are using the combustion chamber and are consequently availing themselves

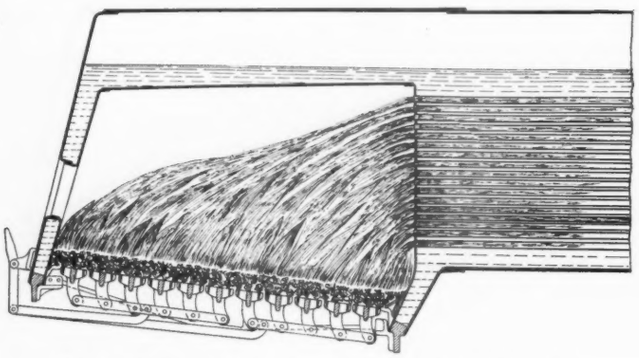


Fig. 1—Flame Action in Firebox without Brick Arch.

of the increased firebox volume, the number so doing is comparatively small, although growing. This is equally true of the brick arch situation. On the other hand, railways that have been using the combustion chamber, properly applied, for any length of time, are aware of the value of this feature; this is also equally true of the roads using the brick arch; both of these features add greatly to economy in fuel consumption and the ability to generate a maximum amount of steam.

Personal experiencce with the Wootten type of firebox convinced me that both the firebox volume and the deflection of

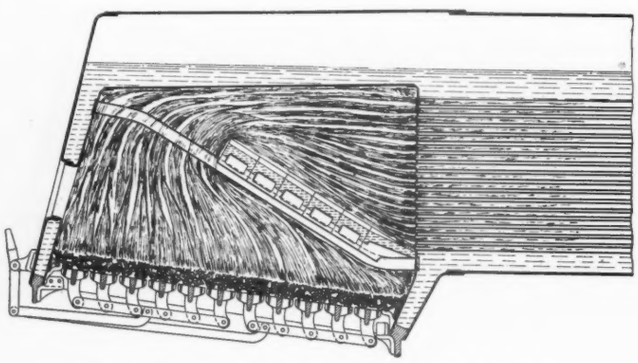


Fig. 2—Flame Action in Firebox with Brick Arch.

gases were important factors. A rather lengthy study of the whole matter resulted in a special design of firebox, embodying the combustion chamber, brick wall with air inlets, and means for cleaning out the cinders collecting in the combustion chamber. Three years' experience with this firebox has shown its value. The actual results will be discussed later.

A brief review of firebox design and of some of the principles embodied in it may be of interest: Fig. 1 shows the regular type of bituminous burning firebox. The flame, rising from the fire seeks the shortest course to the flue. While the sketch indicates that the portion of the flame from the rear end of the firebox travels on a nearly straight line to the top flues, it is more than probable that under the heavy forced draft the actual path would fall short of the top flues, and that the greater part of the gases and flame would pass to the flue sheet some little distance below the top row of flues. It is obvious, under these conditions, that the heating surface embodied in the back head and the back part of the crown sheet and side sheets absorbs a

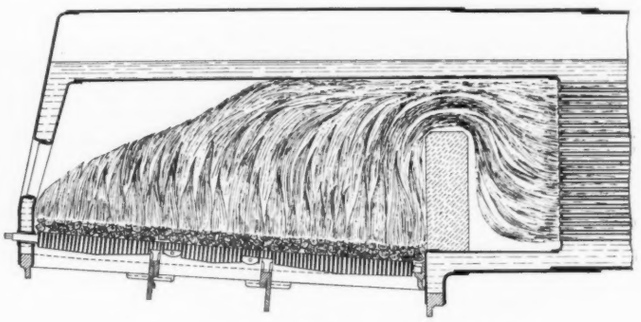


Fig. 3—Flame Action in Wootten Firebox.

very small proportion of the heat that they are capable of absorbing. It is also evident that any attempt at complete combustion of the gases arising from such a fire, by the introduction of air in any manner, stands very little chance of having the desired effect—the movement of the gases being so direct and no provision being made for deflection—between the time they leave the bed of the coals and the time they enter the flue sheets, where, of necessity, due to the reduced temperature, any further combustion is stopped.

The ordinary bituminous firebox with a brick arch is shown

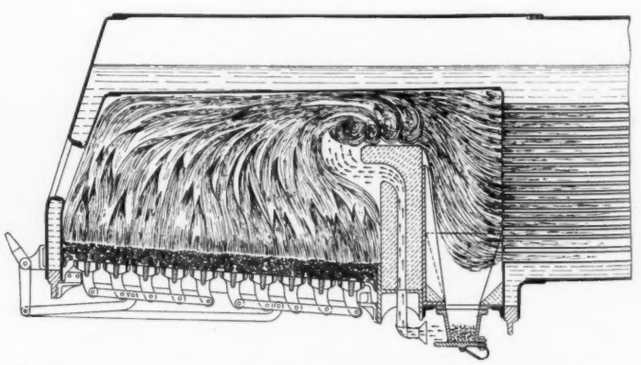


Fig. 4—Flame Action in Firebox with Gaines Combustion Chamber.

in Fig. 2. It is obvious that the introduction of the arch at once brings about an entirely different state of affairs from that existing in the plain firebox. The gases and flame rise from the fire and are thrown back, passing over the top of the arch and then to the flue sheet. It is also obvious that by this means the heat has been brought in closer contact with that portion of the firebox at the rear, which in the plain type does little or no work, thus effecting considerable increase in the generation of

steam on this account. It is also easily seen that the introduction of air from any source would aid combustion and has much more opportunity for effecting this result, as the baffling of the gases by the brick arch gives a chance for the air to mix with the unconsumed gases and for the mixture to burn before striking the flue sheet. This arrangement, while effecting considerable economy over the plain arrangement, has its drawbacks when it comes to extreme widths of firebox; also where the wheels are under the firebox and limit its depth. In many cases the fireboxes on modern engines, especially the consolidation type, are so shallow that it is impossible to get the arch between the flues and fire. In many other cases, owing to the width of the firebox, it is necessary to support the arch at two or more points with arch pipes.

It is also apparent from Figs. 1 and 2 that any cold air entering the firebox is liable in the first case to strike the flue sheet and cool it to an extent that will give trouble with the flues, whether entering from a hole in the front end of the fire or during a prolonged opening of the fire door. In the second case, if the arch is of the type that is solid against the front end, there is little possibility of cold air entering the flues, as the air becomes warm before striking the flue sheet by mingling with the gases in passing over the baffle of the brick arch. In those types of engines using the open arch, or one that is open at the flue sheet, this would still hold true for the admission of air from the door, but any hole in the front end of the fire would cause considerable trouble on account of leaking fiues.

The Wootten firebox is shown in Fig. 3. In this construction additional firebox volume is obtained by the use of a circular combustion chamber surrounded by a water leg, and with a brick wall built up at the back end. It is obvious that more or less of the gases are thrown backward and upward, so as to obtain the same effect as with the brick arch shown in Fig. 2. It is also evident that, as the brick wall is of some considerable height, the firebox itself may be as shallow as the design of the engine may require, as the brick wall prevents the fuel from getting into the flues. Incomplete combustion is minimized in this arrangement, as any air that is admitted is more or less intimately mixed with the gases in passing over the brick wall, and has the opportunity of burning in the combustion chamber before striking the flue sheet.

Mechanically there are some objections to this arrangement. The water leg surrounding the combustion chamber must be of sufficient width, at the bottom especially, to allow good circulation and prevent the burning of the sheets. This, in turn, cuts down the available flue sheet area and prevents the installation of the same number of flues that would otherwise obtain in boiler shell of the same outside diameter. It also becomes necessary, at intervals, to cool off the boiler and remove the accumulation of sparks from the combustion chamber. It will be noted, however, that for blowing out the flues when they are plugged, or working on the flues when leaking, it is not required to dismantle the brick wall. There is also another point that causes trouble due to the junction of the throat sheet with the side and crown sheets; this joint coming in the hottest part of the path of the burning gases sometimes gives trouble from leaking. On the other hand, it is almost impossible to damage the flues by cold air, either from a hole in the fire or from the prolonged opening of the fire door, as such air will be well heated before striking the flue sheet. It is certain, however, that with the Wootten firebox results are obtained in fuel economy, steaming capacity, etc., that cannot be obtained in the other two types above mentioned, and it is more than probable that the increased firebox volume, together with the deflection of the gases by the brick wall, are the most important factors in producing these results.

The problem then becomes one in which these factors can be maintained and the objections referred to eliminated. This was finally accomplished by the design shown in Fig. 4. Here the firebox volume has been increased and the deflection of the gases from the rear is provided for so as to more fully utilize the back portion of the firebox. Also, the introduction of air through the brick wall provides oxygen for complete combustion. This air, entering through the incandescent brick wall, is heated approximately to the temperature of the firebox before mingling with the gases, making the most favorable conditions for complete combustion. The space behind the wall allows an opportunity for their burning before striking the flue sheet. The arrangement also permits of the application of a regular spark hopper at the bottom of the chamber for cleaning, when necessary. It also eliminates the seam between the throat and side sheets at the place where it is liable to give trouble, and at the same time protects the flues from cold air and consequent damage. It will also be noted that under this arrangement the same flue sheet arrangement may be obtained for the same boiler diameter, as in Fig. 1.

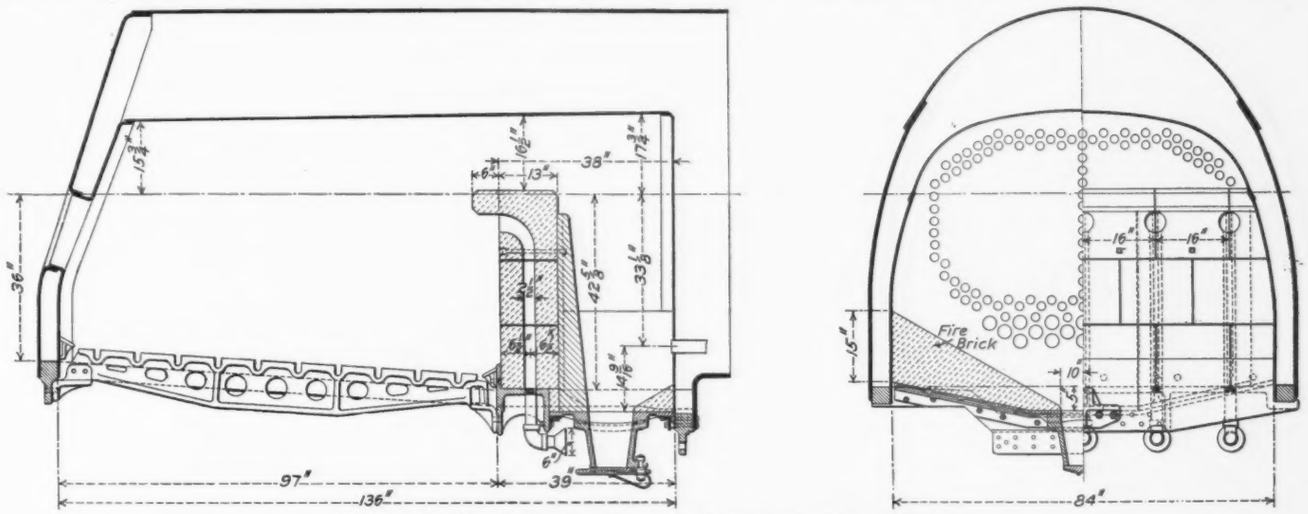


Fig. 5—Details of Construction of Gaines Combustion Chamber.

To check these theories with actual practice an engine was changed, as shown in Fig. 5, by cutting off the entire back head and building a new back head with a firebox approximately equal to the length of the brick wall plus the combustion chamber. The combustion chamber was formed, as shown in the illustration, by building a brick wall on a cross bearing. The engine was put into service in February, 1909—three years ago. The flues applied to the engine at that time have never given any trouble from leaking or stopping up. The engine has been in the shop twice for tire turning, but is still running with the

original flues, having made 80,000 miles to date. On the same division sister engines, as well as engines of equal power in the same service, fail to make an average of over 26,000 to 33,000 miles before the flues require safe-ending and resetting.

A series of tests, using this engine, a sister engine without the combustion chamber, and a wide firebox consolidation of a later design and better proportions, was made in March, 1909. An additional test was also made in February, 1911. Both series of tests were made with the same crews, using a train composed of steel cars loaded with company coal, the same train being used through the series of tests, thus eliminating any variables due to the make-up of the train. All coal used in each test was from the same mine and was mined at the same time and was sacked. The two tests check very closely and show almost identical results. The results from the later test are reproduced herewith and show that the economy of the arrangement is actual and quite considerable.

Engine Number.	Train Number.	Date.	Actual Time Consumed.	Stops. Number.	Stops. Time Consumed.	Pounds coal consumed. Total.	Pounds coal consumed. Per 1,000 ton miles.	Pounds coal consumed. Per hour.	Pounds water evaporated. Total.	Pounds water evaporated. Per pound of coal.	Miles run to one ton of coal.	Tons coal used in excess, based on Engine 1014 as unit of comparison.	Relative efficiency based on coal consumption per mile.
*1014	Extra	1/13/11	6 hr. 34 m.	6	1 hr. 4 m.	11,950	93	1,820	96,800	8.10	16.74	.....	.....
	2/36	1/14/11	6 hr. 42 m.	8	1 hr. 33 m.	13,350	104	1,991	109,000	8.16	14.98	.....	.....
1014	3/37	1/16/11	6 hr. 12 m.	7	49 m.	12,450	97	2,008	105,750	8.49	16.08	.....	.....
	1/36	1/17/11	6 hr. 39 m.	7	1 hr. 12 m.	14,250	111	2,143	109,800	7.71	14.04	.....	.....
....	....	.....	26 hr. 7 m.	..	4 hr. 38 m.	52,000	101	1,991	421,350	8.10	15.38	.....	100.00
†1012	Extra	1/18/11	7 hr. 12 m.	5	57 m.	20,400	159	2,833	121,458	5.95	9.80	.....	.....
	1/36	1/19/11	8 hr. 4 m.	5	1 hr. 16 m.	21,900	170	2,715	124,887	5.70	9.13	.....	.....
1012	Extra	1/20/11	6 hr. 43 m.	5	45 m.	19,087	148	2,841	113,095	5.93	10.48	.....	.....
	2/36	1/21/11	7 hr. 20 m.	8	1 hr. 43 m.	22,500	175	3,068	121,883	5.42	8.89	.....	.....
....	....	.....	29 hr. 17 m.	—	4 hr. 41 m.	83,887	163	2,865	481,323	5.74	9.54	15.94	61.96
§1716	Extra	1/23/11	8 hr.	9	2 hr. 33 m.	15,000	117	1,875	110,400	7.36	13.33	.....	.....
	1/36	1/24/11	7 hr. 24 m.	10	1 hr. 41 m.	16,500	128	2,230	120,000	7.27	11.43	.....	.....
1716	Extra	1/25/11	6 hr. 50 m.	9	1 hr. 20 m.	13,800	107	2,080	102,801	7.45	14.49	.....	.....
	1/36	1/26/11	7 hr. 28 m.	12	1 hr. 42 m.	15,600	121	2,089	117,166	7.51	12,82	.....	.....
....	....	.....	29 hr. 42 m.	..	7 hr. 16 m.	60,900	118	2,050	450,367	7.39	13.14	4.45	85.58

*Engine 1014—21 in. x 32 in. Cooke consolidation—with new firebox and combustion chamber, with hollow brick wall and provision for mixing hot air with burning gases. Total heating surface, 2,987.33 sq. ft.
†Engine 1012—Same class engine as 1014, but with original boiler unchanged, and brick arch. Total heating surface, 3,022.29 sq. ft.
§Engine 1716—22 in. x 30 in. Baldwin consolidation—brick arch. Total heating surface, 3,230 sq. ft.
Analysis of fuel: Moisture, 1.39 per cent.; volatile combustible matter, 30.56 per cent.; fixed carbon, 55.11 per cent.; ash, 12.94 per cent.; sulphur, 1.5 per cent. B.t.u. per lb. dry coal (Mahler Atwater calorimeter), 13,179; B.t.u. per lb. actual coal, 12,996.

It has further been found that when the fuel supply is of a nature which causes steam failures on other engines running in similar service on the division, this engine has not, as yet, given a single steam failure, even when the grade of fuel was considerably below standard. The engine, when in service working steam, emits a minimum amount of smoke; in fact it is almost impossible to make black smoke by leaving both fire doors open and shoveling coal continuously; on the other hand, with an ordinarily good fire the amount of smoke emitted is almost imperceptible.

Another peculiar feature is that a very small amount of sparks are ejected from the stack, and those ejected are in all cases dead. This does not mean that there is any great accumulation in the combustion chamber, being very seldom that more than a few quarts are found in this locality, although the sparks which are found in the combustion chamber are readily removed through the spark hopper in the bottom.

Another rather important feature connected with the burning of soft coal on this engine is the fact that the flues show no indications of plugging up. In going over this matter with the foreman boilermaker of the terminal out of which the engine runs, he states positively that the engine has never been reported, as yet, to have the flues blown out.

Metal Bearings.—The bureau of construction and repair of the U. S. Navy department requires an alloy of 88.8 per cent. Banca tin, 7.5 per cent. regulus of antimony and 3.7 per cent. of best refined copper for all white metal bearings.

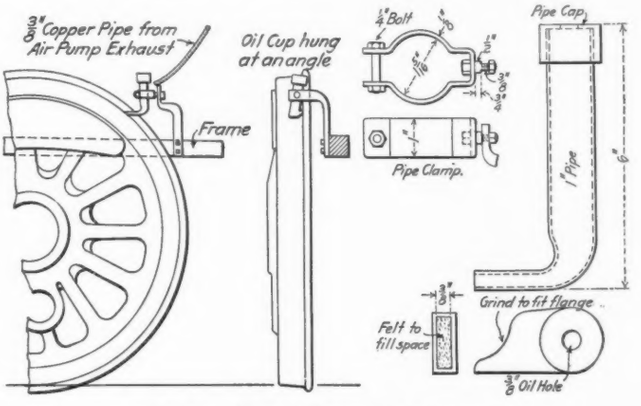
FLANGE LUBRICATOR

BY JAMES STEVENSON

Gang Foreman, Pennsylvania Railroad, Olean, N. Y.

The accompanying illustration shows a flange lubricator which was designed by the writer and may be very easily constructed. It is made of a 1 in. or 1¼ in. pipe flattened and bent at the lower end and ground to fit the flange of the driving wheel. This end should be filled with a closely woven felt, as shown in the drawing, so that the oil may soak through and keep the flange lubricated.

The pipe is held in position by a clamp which is located a little above the center of the pipe. This clamp is free to swing on the bolt which fastens it to the bracket, allowing the lubricator to ride easily on the flange. Should it be desired to oil the flange only when rounding a curve the cup may be arranged so that it just misses the flange when the engine is level. When the engine takes a curve the elevation of the outer rail will raise the engine sufficient to cause the cup to bear against the flange, bringing the lubricating feature into action. A ⅜-in. copper pipe is connected to the air pump exhaust, discharging directly on the oil cup, so as to keep the oil sufficiently warm in cold weather. This feature has been found to be very necessary as the cold will congeal the oil so that it will not run. This device is not patented and the writer would be glad to receive any criticisms concerning it.



Driving Wheel Flange Lubricator.

GENERAL NEWS SECTION

The Pere Marquette engine house, at Ludington, Mich., was recently partially destroyed by fire. Considerable machine tool equipment was destroyed.

The Texas & Pacific has announced its intention to run motor cars regularly between Dallas, Fort Worth and Mineral Wells, Texas. There will be three cars in service.

The Illinois Central has issued an order allowing the wood from 40 worn-out freight cars being dismantled at the Burnside shops to be given away to the poor for fuel.

The carpenter and repair shops of the Hocking Valley, at Walbridge, Ohio, were destroyed by fire January 10; loss, including a coal house, a sand house, an oil house and a material shed, $75,000.

The boilermakers working in the shops of the American Locomotive Company, who have been on strike for three months, in sympathy with the strike of the New York Central boilermakers, have called off the strike.

The fast mail train of the Lake Shore & Michigan Southern on January 2 was run from Cleveland to Toledo, 108 miles, in 105 minutes, making up 40 minutes. The train consisted of 12 cars and was drawn by two engines.

The coroner of Allegheny County, in Pennsylvania, reports that fatalities in factories and mills have decreased 30 per cent. on account of the safety devices that have been installed by the manufacturers, the total for 1911 being 2,657 deaths.

The Hine system of organization has been installed by the Georgia & Florida, and the number of officers is increased. This is intended to abolish the practice of having clerks sign the names of officers, and increases the authority of the officers.

The Julius Pintsch Aktiengesellschaft advises that the Prussian Minister of Public Works has denied a report published in various European papers to the effect that, by action of the Reichstag, at Berlin, the Prussian state railways were to be equipped with electric light.

A statement compiled at the War Department in Washington shows that from sales of scrap iron and other unused material which was left on the Isthmus of Panama by the Frenchmen who did work on the canal fifteen years ago, the government has already realized the sum of $2,112,000.

The Southern Pacific, by making a slight change in the train schedules and by providing for a connection at Port Costa, Cal., between the Shasta Limited from Seattle, and the "Owl" for Los Angeles, has shortened the trip for passengers between Seattle and Los Angeles to 44 hours, a saving of nearly a day.

The Chicago & Eastern Illinois has advanced the wages of enginemen, firemen, conductors and brakemen to the level of the scales paid on the Frisco lines west of the Mississippi river; this in accordance with an agreement reached last year by which the advance was to be made in two instalments. The present advance constitutes the second instalment.

Commissioner Prouty, of the Interstate Commerce Commission, has been elected chairman of the commission, to succeed Chairman Clements. This is in accordance with a rule adopted last year that the term of office of the chairman should be limited to one year and be filled from year to year by different members in the order of seniority in service.

A locomotive boiler exploded January 5 in the engine house of the Southern Pacific at Los Angeles, Cal., and killed two men and injured three. The explosion was caused by low water in the boiler; the force of the explosion lifted the boiler from its frame, leaving the wheels standing on the track, and carried it to a distance of 100 ft. from the engine house.

Forty-six complaints have been filed in the United States district court at New Orleans against the Illinois Central, alleging violations of the safety appliance act. Eleven complaints are brought under the air brake provision of the law, 25 under the provision regarding the use of automatic couplers, and 10 under the provision relating to the use of grab irons.

The New York State Public Service Commission, First district (New York City), has made its fifth annual report. The per capita expenditure of the public of New York City for 1910 is estimated at $16.35 for transportation, $6.68 for gas and $5.32 for electricity, a total of $28.35. The expenses of the commission in supervising such public utilities were $377,000, or a per capita expense of eight cents.

Statistics compiled by the pension department of the Southern Pacific show that since the establishment of the pension department in January, 1903, the sum of $948,538 has been disbursed in pensions to retired employees. The total disbursements for the year 1911 were $184,704. Since the organization of the pension department the Southern Pacific has pensioned 692 of its former employees. The number on the pension roll at the close of 1911 was 467.

The Supreme Court of the United States in an opinion by Justice Van Devanter has upheld the constitutionality of the employers liability act of 1908 in four cases before it, the principal ones being the New York, New Haven & Hartford vs. Mondon and the Northern Pacific vs. Babcock. The Court of Appeals for the state of Connecticut, which held that an action to recover under the law could not be brought in a state court is overruled, and the case remanded.

The Pennsylvania Railroad, encouraged by the reduction in the number of trespassers killed along its lines, as a result of the persistent efforts of its officers during the past four years, intends to redouble its efforts during 1912. New warning notices will be put up and the authorities will be requested to enact more stringent laws. General Manager S. C. Long has issued a circular to officers and employees, and has called upon all employees to assist in decreasing the death roll.

W. B. Spaulding, chairman of the central safety committee of the St. Louis & San Francisco, has compiled a report of the casualties on the Frisco Lines for the last six months of 1911, during which the safety committee plan has been in effect, together with a comparison with the corresponding period of 1910. There was a decrease of 15, or 14 per cent., in the number of persons killed, from 108 in 1910 to 93 in 1911. The number of injured was reduced from 2,050 in 1910, to 2,714 in 1911, a reduction of 236, or 8 per cent.

A resolution has been introduced in congress by Representative Ayres, of New York, calling upon the Interstate Commerce Commission to investigate the repair shops of the railways belonging to the Trunk Line Association. It is declared that the differences in the cost of various parts made by railways vary so greatly as between the shops of different roads that an investigation is needed. Railways are reporting higher costs for repairing cars and engines, yet the workmen in the shops do not see any benefit from the increase.

The Jacobs-Shupert U. S. Firebox Company is to conduct comprehensive tests of the Jacobs-Schupert firebox in comparison with a similar firebox of the ordinary type at Coatesville, Pa. Dr. W. F. M. Goss, Dean of the College of Engineering, University of Illinois, is to act as expert, outlining and afterwards directing the tests. The first series of tests which are to

determine the relative amount of heat absorbed by the fireboxes of the two boilers under similar conditions of operation will begin early in February. A second series, which will concern the low water tests, will begin on or about April 1.

Thomas A. Edison, the inventor, recently held a short conference with W. L. Park, vice-president and general manager; M. K. Barnum, general superintendent of motive power, and C. F. Parker, purchasing agent of the Illinois Central. Arrangements were made for an experimental test of three passenger motor cars to be equipped with storage batteries at the Edison shop. Mr. Edison asserted that the batteries could be charged in 40 minutes for a run of 200 miles. The Chicago Great Western has recently arranged for a test on a branch line of a similar car which has already been tried on the Long Island.

The Indiana Commission has filed in the Federal court a bill of exceptions protesting against the finding by Special Master N. C. Butler, handed in to the court last month, in the case involving the headlight law. The master reported to the court that the order issued by the commission a year ago requiring railways to equip locomotives with headlights of not less than 1,500 candle power, was legal in the sense that the commission had power in the premises, but that it was invalid because its provisions were not sufficiently definite. The commissioners claim that their order is sufficiently definite for use as a basis of action until the status of the law can be settled in the courts.

The Erie Railroad has equipped about 100 of its locomotives, running in suburban passenger service at the New York end of the road with 2-in. single-bell chime whistles, in addition to the ordinary whistle, and has instructed the enginemen to use this smaller and less noisy whistle on all occasions except where the louder one is required as a measure of safety. Some of these smaller whistles have been in use for several months, and the officers of the road find them satisfactory in every respect. A local report says that those suburban residents who have been disturbed and annoyed by the "wild shriek" of the 5 a. m. train may now be expected to become fast friends of the Erie.

The Supreme Court of the District of Columbia has rendered a decision sustaining the claims of Peter H. Murphy, president of the Standard Railway Equipment Company, St. Louis, Mo., against the Baltimore & Ohio, for infringement of the Murphy patents covering the Murphy outside metal car roof. The decree declares the Murphy patents to be valid and to have been infringed by the roof used by the Baltimore & Ohio. A permanent injunction was issued prohibiting the railway company from further use of this roof, except those already applied, pending an appeal to a higher court. The question of the amount of damages to be assessed was referred to the auditor of the court.

The Florida East Coast Railway was opened for traffic through to Key West, Fla., on January 22. This remarkable railway for a distance of about 70 miles is over water and so far from the land that at times the passengers cannot see it. It is a unique and expensive structure, in some places costing $900,000 per mile. It includes six miles of solid concrete viaduct, 81 miles of embankment 30 ft. above low water level, and has 8 fixed and 2 draw bridges. The entire length of the road, from Jacksonville to Key West, is 522 miles. The cost of the road was approximately $37,000,000, all of which was carried by Henry M. Flagler personally until 1909, when $10,000,000 first mortgage bonds were sold.

Darius Miller, president of the Chicago, Burlington & Quincy, has addressed a circular letter to each of the 45,000 employees of the road, announcing the organization of a department of safety similar in its general plan to the safety committees formed on the Chicago & North Western, the St. Louis & San Francisco, the Baltimore & Ohio, the Chicago Great Western and the Delaware, Lackawanna & Western. The department will be in charge of E. M. Switzer, who will have the title of superintendent of safety, and will be assisted by a central or advisory committee, with headquarters at Chicago. On each operating division there will be a sub-committee, with separate sub-committees for some of the more important shops and other places where large numbers of men are employed.

Committees of the Brotherhood of Locomotive Engineers have presented to all of the prominent railways east of Chicago and north of the Ohio river and the Norfolk & Western Railway, a request or demand for increased pay, the percentage called for being from 15 to 25 per cent. The object of the enginemen is to standardize the scale on all lines in this territory, as was done in the cases of the conductors and brakemen in 1910. The General Managers' Association has been asked to appoint a committee to negotiate with a committee of the Brotherhood in order to deal with the question collectively. A definite relation between the wages paid to enginemen and to trainmen and conductors has heretofore always existed, and the enginemen believe that they are entitled to a fixed advantage in wages over these other arms of the service.

During the past month the extreme cold throughout the country was the cause of many delays to trains. This was especially true in the northern and western states, where snowbound trains were "too numerous to mention." At Lynchburg, Va., a passenger train with leaky pipes was frozen to the track and had to be bumped at the rear by three engines to loosen the wheels. On the Great Northern near Java, Mont., a rotary snowplow was knocked off the track by an avalanche and fell over a precipice 100 ft. high. The temperature was 26 degs. below zero. It has been stated that the roads of the country, as a whole, have suffered more from this month's cold spell than they have any other winter during the past eight years, and that the delays and difficulties for the most part were due to the men being unprepared for the severe weather.

On January 22 a rear collision took place on the Illinois Central at Kinmundy, Ill., which resulted in the death of J. T. Harahan, former president of the Illinois Central; F. O. Melcher, second vice-president of the Rock Island Lines; E. B. Peirce, general solicitor of the Rock Island Lines, and E. E. Wright, attorney for the Rock Island Lines in the State of Tennessee. The men were sleeping in Mr. Melcher's business car, which was attached to the New Orleans express, running south bound. The car was of all-wood construction, while the other cars in both trains were of all-steel construction. Four other members of the party escaped without injury, they being in the forward part of the car. The coroner's jury has returned a verdict placing the blame for the accident upon Henry Schniederjohn, operator at Edgewood, and Harry J. Broecker, flagman on train No. 25, the express train which was struck by the Panama Limited. The jury also decided that the railway erred in not maintaining a sufficient interval between the trains. The operator is blamed by the jury for the same reason.

The Pennsylvania Railroad in ten months has decreased the number of serious injuries to employees in its shops by more than 63 per cent., and in recognition of this work the American Museum of Safety, acting as agents for the Travelers' Insurance Company, presented a medal to the company as the American employer who, in its judgment, "had done the most for the protection of the lives and limbs of workmen, by means of safety devices for dangerous machines and processes." The medal was received by Vice-President W. W. Atterbury, head of the operating department. In the fall of 1910 experts from one of the large accident insurance companies were employed and, accompanied by inspectors of the motive power department, inspected all of the road's larger shops. Following this, safety committees were organized on all divisions. As a result, the number of serious injuries per thousand shop employees, which in January was 8.7, was reduced as follows: February, 7.3; March, 8.3; April,

6.0; May, 7.9; June, 5.2; July, 4.7; August, 3.4; September, 3.4; October, 3.2. During this period, the average number of employees was 33,242.

The Pennsylvania announces that its offer to pay its men for valuable ideas has already produced good results. For some reason not disclosed the offer was promulgated only on the Buffalo & Allegheny Valley division, which has only one-fifth of the road's mileage. Suggestions at once came in from all quarters. An engine house clerk won a premium by submitting a plan for increasing economy by the further use of carbon sheets which remain in repair card books, after the cards have been filled up and removed. A tinsmith discovered an improved method for fastening the boxes which contain flags, torpedoes and the medical case in engine cabs. By standardizing the heights of coal gates on tenders, a fireman saw a way to minimize the loss of coal through vibration. He was paid for the idea. At one of the terminals, an appliance for cleaning and sterilizing drinking cups used in coaches was perfected by a car inspector, and he received payment for it. Many worthless suggestions came in, but the officers say that the saving effected by those which are adopted makes it very much worth while to investigate them all. And there is the indirect gain in the added interest that the employees take in their work, and in the watchfulness and originality which is developed.

MEETINGS AND CONVENTIONS

Fuel Association.—The fourth annual convention of the International Railway Fuel Association will be held at the Hotel Sherman, Chicago, May 22-25, 1912.

American Supply and Machinery Manufacturers' Association.—The next joint convention of the American Supply and Machinery Manufacturers' Association, the National Supply and Machinery Dealers' Association and the Southern Supply and Machinery Dealers' Association will be held at the Monticello hotel, Norfolk, Va., May 13-15, 1912. F. D. Mitchell is secretary and may be addressed at 309 Broadway, New York.

Western Canada Railway Club.—Economic organization and maintenance of the freight car repair yard at a terminal point was briefly considered by J. Thomas Warde, chief clerk to general manager, Canadian Pacific, Winnipeg, in a paper presented in December. The location, arrangement and necessary structures for an ideal freight car repair yard were discussed and the more important features of the organization of the forces and the duties of its members were considered.

Canadian Railway Club.—E. B. Tilt engineer of tests, Canadian Pacific, presented an interesting paper on the work of a testing department on a railway at the December meeting. The paper reviewed the history of testing in connection with railways and gave a good description of the organization and methods used on the Canadian Pacific. The importance of the department in connection with the making of specifications, which it was the author's belief should be originated and prepared by it, being submitted to other departments for their criticisms only, was very carefully discussed.

Central Railway Club.—At the January meeting Prof. E. C. Schmidt, of the University of Illinois, presented a most interesting and valuable paper giving the results up to date of his experiments on the effect of cold weather on tonnage rating. The curves and tables included indicated the great importance of the subject, which in many cases is handled very crudely by different companies operating in cold climates. The practice in regard to the reduction of tonnage under different weather and temperature conditions, in use at present on a number of large roads, was shown in a table which accompanied the paper.

New England Railway Club.—Major Chas. Hine, recently elected vice-president and general manager of the Southern Pacific of Mexico, presented a paper on the subject of which he is considered the greatest authority—railway operating organization—at the December meeting. He reviewed the various factors entering into railroading, leading up to a very complete account of his experiments in connection with the Harriman lines, which extended over three years, and which have proved to be most beneficial to all concerned. Major Hine presented his deductions from this experience in a very clear, interesting manner.

Railway Supply Manufacturers' Association.—Circular No. 1 of this association gives such details as are at present available concerning the plans for the exhibits of the Master Mechanics' and Master Car Builders' conventions at Atlantic City, N. J., next June. The exhibits will be as usual on Young's Million Dollar Pier, and 81,764 sq. ft. of exhibit space has been provided, an increase of about 5,500 sq. ft. The arrangement of the space has been considerably improved. The price of space is 40 cents per sq. ft., as before. Space will be assigned on February 15, 1912, at the office of the secretary, J. D. Conway, Oliver building, Pittsburgh, Pa.

International Congress of Engineers.—A conference was held in San Francisco, January 15, to make plans for an engineers' congress to be held in that city in 1915, at the time of the World's Exposition, to celebrate the opening of the Panama canal. Among the societies represented at the conference were the Society of Naval Architects and Marine Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers, American Society for Testing Materials, American Institute of Mining Engineers, the Mining & Metallurgical Society of America, and the American Chemical Society. The chairman of the meeting was Prof. W. W. Durand, of Leland Stanford, Jr., University.

Air Brake Association.—The nineteenth annual convention of the Air Brake Association will be held at the Hotel Jefferson, Richmond, Va., May 7-10, 1912. The program includes the following papers and reports: Friction—Recent Tests of Brake Shoes, by R. E. Auger; The Cleaning Date, by C. P. McGinnis; The Westinghouse P. C. Equipment in Service, by T. F. Lyons; Report of the Committee on Air Hose Failures, by T. W. Dow, chairman; The New York L. T. Equipment, by O. E. Moore; Right-Angled Pipe Fittings in Air Brake Service, by T. L. Burton; Report of the Committee on Recommended Practice, by S. G. Down, chairman; The Westinghouse P. C. Equipment, Questions and Answers, by S. J. Kidder, stereopticon lecture on Recent Air Brake Developments, by W. V. Turner.

RAILROAD CLUB MEETINGS

CLUB.	NEXT MEETING.	TITLE OF PAPER.	AUTHOR.	SECRETARY.	ADDRESS.
Canadian	Feb. 13	Boilers—Past, Present and Future.....	J. W. Harkom.....	Jas. Powell.....	Room 13, Windsor Hotel, Montreal.
Central	Mar. 14			H. D. Vought....	95 Liberty St., New York.
New England.....	Feb. 13	Mechanical Handling of Freight.....	W. C. Carr.....	Geo. H. Frazier..	10 Oliver St., Boston, Mass.
New York.....	Feb. 16	Electric Welding	O. S. Beyer.....	H. D. Vought....	95 Liberty St., New York.
Northern	Mar. 2			C. L. Kennedy...	401 Superior St., Duluth, Minn.
Pittsburgh	Feb. 23	The Use of the Telephone in Railroad Service	G. K. Meyer.....	J. B. Anderson...	Union Station, Pittsburgh, Pa.
Richmond	Feb. 9	Transportation Interests	Wm. H. White.....	F. O. Robinson...	C. & O. Ry., Richmond, Va.
S'th'n & S. West'n	Feb. 15			A. J. Merrill.....	218 Grant Bldg., Atlanta, Ga.
St. Louis.....	Mar. 8	Railroad Shops (Illustrated).....	T. N. Gilmore.....	B. W. Frauenthal	Union Station, St. Louis.
Western	Feb. 20	Car Wheels	C. G. Bacon.....	Jos. W. Taylor...	390 Old Colony Bldg., Chicago.

Western Railway Club.—At the January meeting C. R. Gilman, chief electrician, Chicago, Milwaukee & St. Paul, presented a paper on head end electric lighting. The system used as an illustration was the turbine driven dynamo, either on the locomotive or in the baggage car, having storage batteries floating on the line to come into operation when the steam supply of the turbine was discontinued temporarily. The paper showed that a 17-car train had 872 lamps which gave a total lamp load of 20,627 watts in the case of a 104-volt circuit having 8 c. p. lamps. The losses in the machine and train lines amount to about 22 per cent., so that the dynamo load was 25,219 watts, or the full capacity of the machine. As a matter of fact, the steam pressure is not generally sufficient to allow the generator to give this output, and it was necessary to depend on the batteries to help out while the full load was on the circuit. It appeared that considerable difficulty was incurred with the 110-volt circuit in use on the trains used as an illustration, and this was recently changed to a 60-volt circuit, and the carbon lamps were replaced with tungsten lamps. This resulted in a saving of $660. The lighting service was about 100 per cent. better, the candle power alone having increased 65 per cent.

New York Railroad Club.—Self propelled motor cars was the subject of discussion at the January meeting. W. B. Potter, engineer of the railway department of the General Electric Company, presented a paper in which he briefly considered the value of self propelled cars from the standpoint of the traffic, operating and mechanical departments. After briefly discussing the various distinct types of motor cars which have been built, he explained at some length the details of construction and operation of the gas-electric car designed by the General Electric Company. Tables showing the complete operating cost of a train consisting of a steam locomotive and two coaches compared with a General Electric gas-electric car, both operating 3,900 miles per month, were given, which indicated a gross yearly saving of nearly $7,000 in favor of the motor car. A report of the mileage and expenses of five motor cars on the Minneapolis, St. Paul, Rochester & Dubuque, for three consecutive months in the summer, were presented and showed an expense of less than 12 cents per train-mile. A number of members criticised the figures given for the cost of the steam train in the comparative table. The operation of the storage battery car on the street railways in New York City, where a number are in use, was quite fully reported by an official having charge of them.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.

Air Brake Association.—F. M. Nellis, 53 State St., Boston, Mass. Convention, May 7-10, Richmond, Va.

American Railway Master Mechanics' Assoc.—J. W. Taylor, Old Colony building, Chicago. Convention, June 17-19, Atlantic City, N. J.

American Railway Tool Foremen's Association.—M. H. Bray, N. Y., N. H. & H., New Haven, Conn.

American Society for Testing Materials.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. 39th St., New York.

Car Foremen's Association of Chicago.—Aaron Kline, 841 North 50th Court, Chicago; 2d Monday in month, Chicago.

International Railway Fuel Association.—D. B. Sebastian, La Salle St. Station, Chicago. Convention, May 22-25, Chicago.

International Railway General Foremen's Association.—L. H. Bryan, Brown Marx building, Birmingham, Ala. Convention, July 23-26, 1912.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, Lima, Ohio. Convention, August 15, Chicago.

Master Boiler Makers' Association.—Harry D. Vought, 95 Liberty St., New York. Convention, May 14-17, Pittsburgh, Pa.

Master Car Builders' Association.—J. W. Taylor, Old Colony building, Chicago. Convention, June 12-14, Atlantic City, N. J.

Master Car and Locomotive Painters' Assoc. of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass. Convention, 2d week in September.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio. Convention, May 20-22, Buffalo, N. Y.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y., August, 1912.

PERSONALS

GENERAL.

L. Grimes has recently been appointed master mechanic of the Illinois Central at Jackson, Tenn.

J. A. Gibson has resigned his position as master mechanic of the Peoria & Eastern at Urbana, Ill.

F. J. Walsh succeeds H. M. Brown as master mechanic of the Chesapeake & Ohio at Hinton, W. Va.

P. T. Dunn, master mechanic of the Pennsylvania Lines West, at Chicago, has been transferred to Wellsville, O.

I. Latham has recently been appointed master mechanic of the Nevada & Copper Belt, with offices at Mason, Nev.

L. R. Laizure, master mechanic of the Erie Railroad, at Cleveland, Ohio, has been transferred to Hornell, N. Y.

E. M. Switzer has been appointed superintendent of safety of the Chicago, Burlington & Quincy, with office at Chicago.

James Craig has been appointed chief draftsman of the Boston & Maine, at Boston, Mass., vice M. C. M. Hatch, promoted.

A. G. Trumbull, mechanical superintendent of the Erie Railroad at Cleveland, O., has been transferred to Jersey City, N. J.

G. W. Good has been appointed supervisor of piece work on the New York Central Lines west of Buffalo, with office at Chicago.

L. E. Hassman, master mechanic of the Illinois Central, with office at Clinton, Ill., has resigned, effective February 1, to engage in other business.

J. W. Hopkins, general foreman of the Pennsylvania Lines West, at Richmond, Ind., has been appointed master mechanic, with office at Toledo, Ohio.

E. S. Fitzsimmons, master mechanic of the Erie Railroad at Hornell, N. Y., has been promoted to mechanical superintendent, with headquarters at Cleveland.

A. H. Graham has been appointed master mechanic of the St. Louis, San Francisco & Texas, and the Fort Worth & Rio Grande, with office at Sherman, Tex.

F. K. Murphy, supervisor of air brakes of the Cleveland, Cincinnati, Chicago & St. Louis, has been appointed master mechanic, with office at Brightwood, Ind.

C. E. Gossett, master mechanic of the Minneapolis & St. Louis, at Minneapolis, Minn., has been appointed general master mechanic, and his authority has been extended over the Eastern division.

Maynard Robinson, master mechanic of the Gulf Colorado & Santa Fe, has had his jurisdiction extended over that portion of the Pecos & Northern Texas between Coleman, Tex., and Mile Post 461.

C. E. Boss, master mechanic of the Fort Worth & Rio Grande at Sherman, Tex., has been appointed master mechanic of the Texas & Pacific, with office at Big Springs, Tex., succeeding J. Potton.

P. T. Dunlop, mechanical superintendent of the Gulf, Colorado and Santa Fe, has had his jurisdiction extended over that portion of the Pecos & Northern Texas between Coleman, Tex., and Mile Post 461.

William Gemlo has been appointed acting road foreman of equipment in charge of the Western division and the Fourth district of the Central division of the Minneapolis & St. Louis, with office at Watertown, S. Dak.

Samuel G. Thompson, assistant engineer of motive power of

the Philadelphia & Reading, has been appointed acting superintendent of motive power and rolling equipment, with office at Reading, Pa., succeeding Howard D. Taylor, resigned.

W. T. LEYDEN, road foreman of equipment of the Minneapolis & St. Louis at Watertown, S. D., has been appointed acting master mechanic of the Eastern division, with office at Marshalltown, Ia., succeeding William Gill, granted leave of absence.

F. W. LAWLER has retired from the position of master mechanic of the Cleveland, Cincinnati, Chicago & St. Louis at Brightwood, Ind., having served the company for 41 years. The last 22 years he served as master mechanic. He will be retired on a pension.

F. H. HANSON has been appointed supervisor of materials on the Lake Shore & Michigan Southern; Chicago, Indiana & Southern; Indiana Harbor Belt; Lake Erie & Wheeling; Lake Erie, Alliance & Wheeling, and the Dunkirk, Allegheny Valley & Pittsburgh, with headquarters at Cleveland, O.

WILLIAM SCHLAFGE has been appointed general mechanical superintendent of the Erie Railroad, with office at New York. He was born in Berlin, Germany, on October 11, 1868, and after receiving a common school education attended night school. Mr. Schlafge began railway work in the machine and car shops of the Lehigh Valley at Packerton, Pa., and left that company in 1887, to go to the Minneapolis, St. Paul & Sault Ste. Marie shops at Minneapolis as an apprentice. After completing his apprenticeship he was engaged in various railway and contract shops as mechanic and foreman, and returned to the service of the Soo Line in 1893 as engine house foreman at Gladstone, Mich. He remained in this position until 1898, when he went to the Escanaba & Lake Superior as locomotive fireman. He was later made engineman and then promoted to master mechanic. His next position was engine house foreman at Newark, Ohio, with the Baltimore & Ohio, and three years later he was promoted to general foreman in charge of the locomotive and car departments, with office at Chicago Junction, Ohio, remaining in that position until 1903. Mr. Schlafge went to the Erie in March, 1903, as general foreman at Port Jervis, N. Y., and during the following year was made master mechanic at Jersey City, N. J. In December, 1906, he was made master car builder, with office at Meadville, Pa., and then within the next few months was made general master mechanic and assistant mechanical superintendent of the same road. In October, 1907, he was promoted to mechanical superintendent of the Erie grand division and the New York, Susquehanna & Western, with office at Jersey City, which position he held at the time of his appointment as general mechanical superintendent of the Erie system.

W. Schlafge.

J. W. SMALL, whose appointment as superintendent of motive power of the Southern Pacific Lines in Texas, with office at Houston, Tex., was announced in the January issue, has been appointed also superintendent of motive power of the Louisiana Western, and of Morgan's Louisiana & Texas Railroad & Steamship Company.

JOSEPH A. BOYDEN has been appointed master mechanic of the Mahoning division of the Erie Railroad, with office at Cleveland, Ohio. He was born in September 2, 1876, at Susquehanna, Pa., and was educated at the high schools and at Wyoming Seminary. Mr. Boyden began railway work on November 6, 1892, as an apprentice at the Susquehanna shops of the Erie; after completing his apprenticeship in 1896, he spent one year in the drafting room. In January, 1898, he went to the Pere Marquette as a machinist at Saginaw, Mich., and in February of the following year returned to the service of the Erie Railroad as a machinist at Susquehanna. In August, 1899, he was transferred in the same capacity to Dunmore, Pa., and in February, 1900, he was again transferred to the Baldwin Locomotive Works at Philadelphia, inspecting the engines being built for the Erie. He returned to the Susquehanna shops in September of the same year, and in January, 1901, was promoted to machine shop foreman at Port Jervis, N. Y. He was again promoted in February, 1904, to general foreman at Newburgh, N. Y., and in March, 1905, was transferred as general foreman to Bergen, N. J. Four years later he was again transferred as general foreman to Cleveland, Ohio, and since April 1, 1911, has been general foreman at Hornell, N. Y. Mr. Boyden is first vice-president of the International Railway General Foremen's Association.

J. A. Boyden.

J. F. SHEAHAN, master mechanic of the Georgia & Florida, at Douglas, Ga., who, as stated in the January issue of the *American Engineer*, was appointed assistant superintendent, began railway work in 1880, at the Renova shops of the Pennsylvania Railroad, and was later transferred to Camden, N. J. Previous to May, 1888, he held various positions, and was then appointed master mechanic of the Orange Belt Railway, now a part of the Atlantic Coast Line, and in July, 1895, became master mechanic of the Florida Southern at Palatka, Fla. He was then for eight months master mechanic on the Plant System. In June, 1897, he was made night roundhouse foreman of the Southern Railway. The following August he was appointed erecting shop foreman, and one month later became general foreman at Alexander, Va. He was promoted to master mechanic of the Southern Railway in January, 1900, at Selma, Ala., and then served in the same capacity consecutively at Columbia, S. C., Spencer, N. C., Atlanta, Ga., and

J. F. Sheahan.

Knoxville, Tenn. Mr. Sheahan left the service of the Southern Railway in January, 1910, and went to the International & Great Northern as master mechanic at Palestine, Tex. In December, 1911, he was appointed master mechanic of the Georgia & Florida, with office at Douglas, Ga., and on January 1, 1912, when the Hine system of organization was established by the Georgia & Florida, he became assistant superintendent, with office at Douglas.

R. J. Turnbull, assistant superintendent of machinery of the Missouri Pacific at St. Louis, Mo., has been appointed acting superintendent of machinery, with office at St. Louis, succeeding J. W. Small, resigned to accept service with another company.

D. M. Perine, whose appointment as superintendent of motive power of the New Jersey division of the Pennsylvania Railroad, with office at Jersey City, N. J., was announced in the January issue of the *American Engineer*, was born in Baltimore, Md., February 13, 1869, and was educated in the schools of that city, taking the full course in mechanical drawing and design at the Maryland Institute of that city. He entered the service of the Pennsylvania Railroad as an apprentice at the Mt. Vernon shops of the Northern Central on May 14, 1888. On April 1, 1894, he was appointed assistant road foreman of engines on the Pittsburgh division, and on August 1, 1895, was promoted to assistant master mechanic of the Altoona machine shops. On March 6, 1899, he was appointed assistant engineer of motive power of the Northern Central and the Philadelphia and Erie, and in 1900 was transferred to Altoona as assistant engineer of motive power of the Pennsylvania. On October 1, 1911, he was promoted to master mechanic of the Pittsburgh division, and on August 1, 1903, was transferred to West Philadelphia as master mechanic of the West Philadelphia shops. On April 1, 1906, he was advanced to superintendent of motive power of the N. C. and P. & E., and on April 1, 1907, was transferred to Pittsburgh as superintendent of motive power of the Western Pennsylvania division. On January 1, 1912, he was again transferred to superintendent of motive power of the New Jersey division. The headquarters of this division is located at Jersey City.

D. M. Perine.

J. T. Wallis, whose appointment as general superintendent of motive power of the Pennsylvania Railroad, with headquarters at Altoona, Pa., was announced in the January issue of the *American Engineer*, was born on June 11, 1868, at New Orleans, La., and was educated in the public schools of his native town, the University of Louisiana (now Tulane University), Georgetown College, and was graduated from Stevens Institute with the degree of mechanical engineer in 1891. The same year he entered the service of the Pennsylvania Railroad as an apprentice at the West Philadelphia shops, and has since then served the company as assistant foreman of engines, assistant master mechanic, assistant engineer of motive power, master mechanic, and superintendent of motive power. Mr. Wallis was appointed superintendent of the West Jersey & Seashore on May 1, 1910, which position he held at the time of his recent promotion to general superintendent of motive power.

John Moore James, whose appointment as superintendent of motive power of the Western Pennsylvania division of the Pennsylvania Railroad has been announced in the January issue of the *American Engineer*, was born on September 10, 1875, at Wellsville, Ohio, and was educated in the public schools of his native town and at the Ohio State University. He entered the service of the Pennsylvania Railroad as a machinist apprentice in the Altoona shops in 1893, and was appointed assistant foreman of car inspectors at Washington, D. C., in May, 1899. The following January he was made foreman of the Anacosta shops of the Philadelphia, Baltimore & Washington, and in May of the same year was promoted to general foreman at Washington. He was appointed general inspector of the Buffalo & Allegheny Valley division in October, 1900, and became assistant engineer of motive power of that division in January, 1902. The following December he was appointed master mechanic at the Olean, N. Y., shops, and in November, 1908, was transferred in the same capacity to the Buffalo division. He was again transferred on May 1, 1911, as master mechanic to the West Philadelphia, Pa., shops, which position he held at the time of his recent appointment as superintendent of motive power of the Western Pennsylvania division, with office at Pittsburgh, Pa.

J. M. James.

T. Rumney, general mechanical superintendent of the Erie, has been appointed assistant vice-president of the Rock Island Lines, in charge of the mechanical department, with office at Chicago. This appointment gives Mr. Rumney the most important title yet held by the head of the mechanical department of any large railway in the United States, and indicates the growing conviction that the importance of this department deserves that it shall have a representative on the executive staff, who will be clothed with sufficient authority to give the department the freedom and opportunities it requires for the best results. Mr. Rumney's rise to his present position has been very rapid, as may be seen from the following incomplete account of his railway experience, which was gathered from various sources. It appears that in 1896 he was foreman of locomotive repairs on the Central of Vermont at Malone, N. Y. In 1898 he was listed as master mechanic of the Ogdensburgh & Lake Champlain at Malone, N. Y. In 1903 he was a general inspector of machinery on the Erie at Meadville, Pa. In 1904 he was a master mechanic on the same road,

T. Rumney.

with headquarters at Jersey City, N. J. In 1905 he became assistant mechanical superintendent of the Erie at Meadville, Pa., and in the early part of 1907 was promoted to mechanical superintendent, succeeding G. W. Wildin. In October, 1907, he was appointed general mechanical superintendent of the road, with headquarters at New York. He has been very active in the work of the American Railway Master Mechanics' Association during the past 6 years, and is at present second vice-president of it. He has occupied the important position of chairman of the stoker committee for the last 4 years, and was on the executive committee for 2 years. Previous to that he was a member of committees on Mallet compounds and on the history of the movement of locomotives at terminals.

J. A. REYNOLDS has been appointed district foreman on the Denver, Northwestern & Pacific, with office at Fraser, Colo. He will have charge of the Mallet helper locomotives running out of Fraser and all the locomotives in the district west of Fraser.

MAJOR CHARLES HINE, who, as special representative of the director of maintenance and operation of the Harriman Lines, has had charge of the installation of the unit system of organization on those lines, has been elected vice-president and general manager of the Southern Pacific of Mexico and the Arizona Eastern, with office at Tucson, Ariz.

CAR DEPARTMENT.

L. A. SCHACKELFORD has been appointed foreman of the car department of the International & Great Northern at Taylor, Tex.

S. LINDMAN has been appointed foreman of the car department of the Lake Shore & Michigan Southern, with office at Nottingham, O.

P. W. HELWIG, general car foreman of the Minneapolis & St. Louis at Minneapolis, Minn., will have charge of car work over the Eastern Division.

W. D. MOONEY has been appointed division general foreman car department of the Lake Shore & Michigan Southern and the Lake Erie, Alliance & Wheeling, with office at Collinwood, O.

C. H. HITCH, general car foreman of the Cincinnati, Hamilton & Dayton, has been transferred from Ivorydale, O., to Lima, and will have charge of the freight and passenger car repairs at that point.

T. H. GOODNOW, master car builder of the Lake Shore & Michigan Southern at Englewood, Ill., has been appointed general superintendent of shops of the Armour Car Lines, with office at Chicago, succeeding W. E. Sharp, resigned.

J. W. SENGER, supervisor of materials in the locomotive and car department of the Lake Shore & Michigan Southern at Cleveland, Ohio, has been appointed master car builder, with headquarters at Englewood, Ill., succeeding T. H. Goodnow, resigned.

T. N. RUSSELL, general inspector in the car department of the Cincinnati, Hamilton & Dayton at Lima, Ohio, has been appointed superintendent of the car department, attached to the office of superintendent of motive power and car department at Cincinnati, Ohio.

SHOP.

C. A. WELSH has been made engine house foreman of the Rock Island shops at Little Rock, Ark.

A. B. WILSON has been appointed shop foreman at the Albany, Ore., shops of the Southern Pacific.

T. F. LALLY has been appointed engine house foreman on the Lake Shore & Michigan Southern at Elyria, O.

D. A. STARK has been appointed master boilermaker of the St. Louis, Brownsville and Mexico with headquarters at Kingsville, Tex.

J. K. MORGAN has been made general foreman of the Rock Island shops at Little Rock, Ark., vice G. W. Cooper, resigned.

H. J. KOESTER has been appointed general foreman of locomotive repairs on the Virginia Southwestern, with office at Bristol, Va.-Tenn.

C. G. HESS has been appointed general foreman of the St. Louis, San Francisco & Texas, at Fort Worth, Tex., having been promoted from engine house foreman.

PURCHASING AND STOREKEEPING.

JOHN C. KUHNS has been appointed purchasing agent of the Illinois Central at Chicago, vice C. F. Parker.

JOHN H. GUESS has been appointed general purchasing agent of the Grand Trunk, with office at Montreal, Que.

C. H. KENZEL, assistant purchasing agent of the Elgin, Joliet & Eastern at Chicago, has been promoted to purchasing agent, and his former position has been abolished.

W. C. BLAKE has been appointed division storekeeper of the J. & O. district of the Mobile & Ohio, with office at Jackson, Tenn., succeeding E. T. Bracken, transferred.

CLARENCE F. PARKER, purchasing agent of the Illinois Central at Chicago, has been elected vice-president in charge of purchases and supplies, with headquarters at Chicago, a new office.

A. C. MANN, chief clerk in the purchasing department of the Illinois Central at Chicago, has been appointed assistant purchasing agent, with headquarters at Chicago, succeeding John C. Kuhns, promoted to purchasing agent.

OBITUARY

W. W. LOWELL, master mechanic of the Chicago, Burlington & Quincy, at St. Joseph, Mo., died on January 8.

W. F. BUCK, superintendent of motive power of the Atchison, Topeka & Santa Fe, with office at Chicago, died early Wednesday morning near San Bernardino, Cal., while being brought in a special train to Los Angeles, Cal., from a hospital at Albuquerque, where he had been ill with tonsilitis. Mr. Buck entered railway service as a machinist on the Northern Pacific. In 1893 he was made shop foreman on that road, and two years later general foreman of the shops at Missoula, Mont. In 1899 he was transferred, with the same title, to Helena, Mont., and three years later was made master mechanic of the Rocky Mountain division. In 1904 he went to the Atchison, Topeka & Santa Fe as master mechanic at Needles, Cal. He was made mechanical superintendent of the Eastern Grand division of the same road in April, 1906, and was promoted to superintendent of motive power in January, 1908, with office at Chicago.

W. F. Buck.

NEW SHOPS

Atchison, Topeka & Santa Fe.—A contract has been given to C. A. Fellows at about $65,000, it is said, for putting up a reinforced concrete 25-stall engine house at Barstow, Cal. The contract for the engine house at Riverbank, Cal., has been relet to the Unit Construction Company, San Francisco, for about $60,000. It is reported that an engine house and repair shop will be built at National City, Cal. The road is planning on equipping its machinery in the Kingman, Ariz., shops with electric drive.

Atlantic Coast Line.—It is reported that shops for the manufacture of flat and box cars and passenger coaches will be built at Wilson, N. C.

Bangor & Aroostook.—The engine house which was recently destroyed by fire at Houlton, Me., will be rebuilt. A machine shop will also be added to the structure.

Canadian Pacific.—As was reported last month, this company will erect shops at Calgary, Alberta. They will consist of 20 buildings which will give employment to 5,000 men. The locomotive shop alone will cover six acres.

Chicago, Milwaukee & St. Paul.—The engine house at Perry, Iowa, will be enlarged and a mechanical coaling station will be installed.

Chicago, Rock Island & Pacific.—A new ten-stall engine house will be built at Topeka, Kans.

Cleveland, Cincinnati, Chicago & St. Louis.—This road proposes to build a new engine house this year at Elkhart, Ind., also one at Carey, Ohio, and one at Terre Haute, Ind.

Cincinnati, New Orleans & Texas Pacific.—Preparations are being made by the motive power department for the layout of new shops at Ludlow, Ky.

El Paso & Southwestern.—Plans have been prepared for an 8-track yard, engine house, repair shops, freight warehouse, office building and passenger station at Tucson, Ariz.

Erie Railroad.—This company, which leases the New Castle branch of the Sharon Railway, will build an engine house at Ferrona, Pa. Large locomotive and car-repair shops will also be built by this road at Marion, Ohio.

Kansas City, Mexico & Orient.—A 20-stall engine house and shops will be built at Fort Stockton, Tex.

Kansas City Southern.—It is reported that this road will build a new engine house and shops at De Quincey, La.

Lake Superior Terminal & Transfer Company.—Construction work will be started in the early spring on a new engine house and machine shop at Superior, Wis.

Louisville & Nashville.—The new shops at Boyles, which have been under construction for about two years, were recently placed in operation. The cost of the improvements was about $1,000,000.

New York Central Lines.—Plans have been made for yards and repair shops at Miller, Ind. The shops will employ about 1,000 men.

Northwestern Pacific.—A contract for new shops and a 56-stall engine house at Yardley, Wash., is about ready to be let. The construction of a large engine house and machine shop at Centralia, Wash., is to be started at once.

Oregon-Washington Railroad & Navigation Company.—A contract has been given to Grant, Smith & Company, Seattle, for the erection of a machine shop, 90 ft. x 180 ft., a power house, 40 ft. x 90 ft., and a storehouse, 36 ft. x 36 ft., at Argo, Wash. All of the buildings will be reinforced concrete construction. It is also reported that a contract for new shops at Tacoma, Wash., will soon be let.

Pacific Electric.—It is understood that this road will put up new shops at Dominguez, Cal., about 13 miles from Los Angeles. The estimated cost of improvements is $250,000.

Philadelphia & Reading.—It is reported that this road will construct a car-repair shop in the vicinity of Pottsville, Pa.

Pan Handle, Pecos & Gulf.—Plans are being made for the erection of shops and an engine house at Pecos, Tex.

St. Louis & Southwestern.—The machine and boiler shops of this road at Pine Bluff, Ark., were destroyed by fire, with a loss of $80,000. They will be rebuilt.

St. Louis, Brownsville & Mexico.—It is planned to enlarge the shops at Kingsville, Tex., to almost double their capacity.

St. Louis, Iron Mountain & Southern.—A new 30-stall engine house will be built at Argenta, Ark.

Seaboard Air Line.—It is reported that 150 acres of land at Nortima, N. C., has been purchased for new repair shops.

Southern Pacific.—This road is said to be arranging for an addition to its repair shops at Sacramento, Cal., by filling in the adjacent property.

Texas & New Orleans.—Erection of a new engine house at Beaumont, Tex., will soon be started.

Toledo, Peoria & Western.—A new engine house, 50 ft. x 75 ft. is being built at Galesburg, Ill.

Western Pacific.—An engine house will be built at Marysville, Neb.

Radiator Paint.—Prof. C. L. Norton, of Boston, Mass., made a long series of experiments upon the transmission of heat through and from painted surfaces. Taking the amount of heat radiated from a new pipe as 100, Professor Norton obtains the following relative values for the heat radiated, under similar conditions, from pipe treated as indicated:

Loss of Heat at 200 Lbs. Pressure from Bare Pipe.

New pipe	100
Fair condition	116
Rusty and black	119
Cleaned with caustic potash, inside and out	116
Painted dull white	120
Painted glossy white	100.5
Cleaned with potash again	116
Coated with cylinder oil	116
Painted dull black	120
Painted glossy black	101

It appears from the foregoing that the color of the pipe has little or no effect upon the radiation of heat, though the condition of the surface with respect to glossiness or dullness has quite a sensible influence. Thus a dull surface, whether it be white or black, has a radiative power of 120, and a glossy surface, whether white or black, has a corresponding power of only about 101.

Locomotive Development in Asia.—The countries of China, Japan and Manchuria have been leaders in the adoption of American locomotives and the increase in locomotive orders during the past five years has been about four times greater than during the previous five years. The South Manchuria Railways have ordered as many as 180 locomotives at a time. These included consolidations of 38,510 lbs. tractive effort, the weight of the locomotive being 171,000 lbs.; also Pacific type engines of 25,600 lbs. tractive effort, with a weight of 197,000 lbs. One of the recent shipments was for the Korean lines of the Imperial Government railways of Japan, and consisted of 9 ten-wheel locomotives, having a total weight of 150,000 lbs., with 117,000 lbs. on drivers. The cylinders were 20 in. x 26 in., the driving wheels 66 in. in diameter, the boiler pressure of 180 lbs. and the tractive effort 24,100 lbs.

SUPPLY TRADE NOTES

E. H. Baker has been made second vice-president of the Galena Signal Oil Company, Franklin, Pa.

James B. Brady has been elected vice-president of Manning, Maxwell & Moore, New York, succeeding W. O. Jacquette.

The Standard Steel Works Company, Philadelphia, Pa., has opened a branch office in the First National Bank building, Denver, Col.

The Railway & Mill Equipment Company, New Orleans, La., has been established to sell railway supplies. Seely Dunn and J. Otho Elmer are officers.

Henry C. Valentine, president of Valentine & Company, New York, varnish manufacturers, died at his home in New York, January 15, at the age of 82.

The Columbia Nut & Bolt Company, Bridgeport, Conn., has added a complete line of hot pressed and cold punched castellated nuts to its line of railway supplies.

Morris E. Ward, general sales agent of the Chicago-Cleveland Car Roofing Company, Chicago, died in Chicago on January 7 of a complication of diseases at the age of 68 years.

D. G. Kimball, formerly with the Chicago sales office of Hill, Clarke & Company, has been appointed sales manager of the Wallcott & Wood Machine Tool Company, Jackson, Mich.

W. E. Sharp has resigned his position as master car builder of the Lake Shore & Michigan Southern to become vice-president and general manager of the Grip Nut Company, New York.

F. M. Gilmore, formerly in the railway department of the H. W. Johns-Manville Company, New York, has gone to the Chicago Car Heating Company, Chicago, with office in that city.

The Smith Locomotive Adjustable Hub Plate Company, Pittsburg, Kan., is equipping a number of new locomotives for the St. Louis & San Francisco and the Missouri Pacific with its adjustable hub plates.

W. O. Jacquette has resigned as vice-president of Manning, Maxwell & Moore, Inc., New York. He has made no plans for the future, but for the present will make his headquarters at 165 Broadway, New York.

Charles R. Crane has been elected head of the Crane Company, Chicago, to succeed his father, the late Richard T. Crane. R. T. Crane, Jr., is the new first vice-president, and R. T. Crane, 3d, was made second vice-president.

Following are the newly elected officers of the Watson-Stillman Company, New York: Vice-president, E. A. Stillman; treasurer, J. P. Bird; secretary and works manager, A. F. Stillman; chief engineer, Carl Wigtel.

C. E. Tripp, of the Stone & Webster Engineering Corporation, Boston, Mass., has been made chairman of the board of directors of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., succeeding Robert Mather, deceased.

Charles M. Lyle has resigned his position with Manning, Maxwell & Moore, New York, to go with the Niles-Bement-Pond Company as manager of its St. Louis office. Mr. Lyle was connected with the Niles-Bement-Pond Company about nine years ago.

Joseph T. Ryerson & Son, Chicago, have opened a branch office in the Ford building, Detroit, Mich., in charge of J. H. Marlotte. This company has also moved its Minneapolis, Minn., office to 501 Third street, South Minneapolis, where larger floor space has been secured.

C. A. Delaney, for a number of years superintendent of the Dickson works of the American Locomotive Company, with office at Scranton, Pa., and later sales representative at that place, has been made Western representative of the company with office in Chicago.

W. H. Lawrence has been made manager of the waterproofing and mastic department of the H. W. Johns-Manville Company, New York, with office in Chicago. Mr. Lawrence will have supervision of all the waterproofing work of the company throughout the country.

The Spencer Otis Company, Chicago, has recently moved its main office to room 747, Railway Exchange building, Chicago, where a new feature has been introduced in the way of exhibiting several of the company's devices. The American Kron scale for railway work is exhibited in all sizes and capacities. The company will shortly open an office in San Francisco, Cal.

The Independent Pneumatic Tool Company, Chicago, has recently placed on the market a new One Man drill, which is equipped with compound planetary gears, and is particularly adapted for drilling, tapping and screwing in staybolts and studs of all sizes up to 1¼ in. This drill is of the reversible type, weighs 20 lbs. equipped with a No. 3 Morse taper socket, and has Corliss valves.

The Standard Railway Equipment Company, Pittsburgh, Pa., and the Monarch Pneumatic Tool Company, St. Louis, Mo., will in future keep their respective orders and business transactions separate. The Standard company will receive all orders for roof materials and carlines, and the Monarch company will receive all orders for pneumatic tools. P. H. Murphy is president of the Standard company and William Miller is president of the Monarch company.

The United Car Company, with offices in the Commercial National Bank building, Chicago, which has recently been organized with C. H. Thomas, F. A. Hecht and E. R. Davis as directors, has purchased the entire plant and equipment of the American Car & Equipment Company, Chicago Heights, Ill., including a large erecting shop, blacksmith shop, offices, etc. It will build and rebuild cars and handle railway supplies in general, making a specialty of steel underframes and tank cars. Mr. Thomas is president of the company; Mr. Hecht is vice-president; and N. B. Hall is secretary.

George W. Fowler, for many years sales manager of the Garwood Electric Company, New York, and W. J. Warder, Jr., formerly chief engineer and superintendent of Roth Brothers, Chicago, and later with the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., have resigned to enter the sales department of the Crocker-Wheeler Company, Ampere, N. J. A. K. Selden, Jr., for some years in charge of the design of motors for the Electro Dynamic Company, New York, has resigned to enter the engineering department of the Crocker-Wheeler Company.

Richard T. Crane, president of the Crane Company, Chicago, died at his home January 8. Mr. Crane was born in Paterson, N. J., in 1832, and worked in machine shops in Paterson, New York and Brooklyn, N. Y., until he was 23 years old, when he moved to Chicago. An uncle, Martin Ryerson, gave him a small piece of land on which he started a brass foundry. His brother, Charles S. Crane, subsequently joined him, and the machine manufacturing company of R. T. Crane & Brother was formed. This concern later grew into the Northwestern Manufacturing Company, and after that into the Crane Brothers Manufacturing Company, from which it evolved into the Crane Company. Mr. Crane was well known because of his aggressive opposition to the present methods of higher education.

Charles C. Leech, for the past ten years foreman in charge of the Pennsylvania shops at Buffalo, N. Y., has resigned to accept the position of general manager of the American Roller Bearing Company, Pittsburgh, Pa. Mr. Leech is well-known to

the readers of the *Railway Age Gazette* Shop Section and of the new *American Engineer,* because of his many contributions to the various competitions which have been held during the past two years. He was awarded the first prize in the engine house kink competition, which closed March 15, 1911; second prize in the car department kink competition, which closed November 15, 1910; first prize in the shop kink competition, which closed May 15, 1911, and second prize in the competition on shop improvements during 1911, which closed December 15, 1911.

On December 28, 1911, Judge Christian C. Kohlsaat, of the United States Circuit Court, decided the case of the Railroad Supply Company, Chicago, against the Hart Steel Company, Elyria, Ohio, and Guilford S. Wood, Chicago, pending in the United States Circuit Court for the northern district of Illinois, and dismissed the bill for want of equity, holding that, while the three Wolhaupter patents, upon which the suit was instituted, were valid under the state of the art shown by the record, the claims must be limited to the devices described in the specifications, and that when so construed the device sold by the defendants did not infringe. An appeal was at once prayed and allowed to the United States Circuit Court of Appeals for the seventh circuit, and will be heard at the April session of that court in Chicago. The companion suit against the Elyria Iron & Steel Company, Elyria, will be heard before Judge Day in the federal court at Cleveland in January, 1912.

The Baldwin Locomotive Works has recently purchased 370 acres of land in the vicinity of Gary, Ind. It is triangular in shape; on the south line are the Elgin, Jolliet and Eastern Railway and the Chicago, Lake Shore & South Bend Electric. On the north is the joint right of way of the Pennsylvania and the Baltimore & Ohio Chicago Terminal. It is the intention to start the erection of the power house, foundry and forge shop for the manufacture of castings and forgings which will supply a plant capacity of ten locomotives a week. After this portion of the plant is complete the machine and erecting shops will be erected. The whole plant when completed will provide facilities for an output of 30 locomotives a week and will employ 5,000 men. The works are located within 3 miles of the American Steel Foundry, the Standard Forging Company, the Midland Steel Company, the Universal Cement Company, the Buckeye Steel Castings Company and the American Bridge Company. The Indiana Steel Company at Gary is within five miles, and the tract purchased by the American Locomotive Company is within seven miles.

De F. Lillis, for many years connected with the New York Central Lines, has been appointed Eastern sales agent of the Grip Nut Company, with headquarters in New York. Mr. Lillis was born in Ottawa, Ill., where he received a common school, high school and business college education. He learned the printing trade and worked at it for several years in Ottawa, Peru and Chicago. In August, 1886, he entered the service of the Lake Shore & Michigan Southern as a stenographer to the local attorney at Chicago. After filling several minor positions in the law and operating departments he became chief clerk to John Newell, the president and general manager, in September, 1887. He remained in this position until Mr. Newell's death in 1894, and served in the same capacity during the administrations of three of Mr. Newell's successors, D. W. Caldwell, S. R. Galloway and W. H. Newman. In April, 1899, he came to New York as secretary to Arthur M. Waitt, superintendent of motive power and rolling stock of the New York Central & Hudson River. He was secretary and executive clerk to J. F. Deems, general superintendent of motive power, rolling stock and machinery of the New York Central Lines from April 1, 1903, to November 15, 1911. From that time until January 1, 1912, he was connected with the office of the president, W. C. Brown. It is needless to say that Mr. Lillis has a wide acquaintance both in railway and railway business circles.

CATALOGS

Valves.—The National Tube Company, Pittsburgh, Pa., has recently issued bulletin No. 7, describing its regrinding valve.

Mechanical Stokers.—The E. R. Allen Foundry Company, Corning, N. Y., has issued a pamphlet devoted to the Elliott mechanical stoker.

Compressors.—The Ingersoll-Rand Company, New York, has published form No. 3211 on Imperial type X, duplex, steam-driven compressors.

Gage Glass Protectors.—The Ashcroft Manufacturing Company, New York, has published a small folder on the Ashcroft gage glass protectors.

Furnaces.—Tate, Jones & Company, Inc., Pittsburgh, Pa., has published an attractive 30-page catalog of its furnaces for heating, forging and welding.

Carbonizing Coating.—The Goheen Manufacturing Company, Canton, Ohio, has published a pamphlet on carbonizing coating for preserving iron and steel construction.

Fans.—The American Blower Company, Detroit, Mich., has published "Fact Bulletin" No. 3, giving the present standing of several suits between this company and other fan manufacturers.

Compressors.—The Chicago Pneumatic Tool Company, Chicago, has published bulletin No. 34 H, which gives general instructions for installing and operating the Chicago pneumatic compressors.

Refrigeration and Ventilation.—Burton W. Mudge & Company, Chicago, have published an illustrated booklet on the Garland system of ventilation, heating and refrigeration applied to refrigerator cars.

Metallic Hose.—The American Metal Hose Company, Waterbury, Conn., has published a small illustrated folder on flexible metal hose for steam, oil, gas, suction, air or conduit, in which dimensions and prices are given.

Boring and Turning Mills.—The Betts Machine Company, Wilmington, Del., has published a 100-page catalog illustrating and describing its heavy machine tools. They are especially adapted for locomotive and car shops.

Piping Materials.—The Best Manufacturing Company, Pittsburgh, Pa., has recently published a 395-page catalog, bound in cloth, in which is given the sizes and list prices of its piping, valves, tees, elbows, steam separators, water columns, etc.

Recording Instruments.—The Uehling Instrument Company, Passaic, N. J., has recently issued bulletin No. 2, which is a condensed catalog of its recording instruments. The bulletin contains illustrations of pressure, vacuum, draft, revolution and CO_2 recorders.

Pneumatic Tools.—The Independent Pneumatic Tool Company, Chicago, has published a small illustrated folder giving the advantages and the dimensions of the various Thor pneumatic tools, including piston air drills, pneumatic hammers, staybolt drivers, air appliances, etc.

Locomotive Cranes.—The Browning Engineering Company, Cleveland, Ohio, has published an attractive and useful catalog descriptive of the various types of Browning locomotive cranes and the many different uses to which the cranes and their various attachments are adapted.

Ventilators and Door Closers.—Burton W. Mudge & Company, Chicago, have issued two illustrated folders, one describing the Garland ventilator for passenger cars, which is now in use on about 6,000 cars of the Pullman Company, the other describing the Garland door closing and opening device for refrigerator cars.